

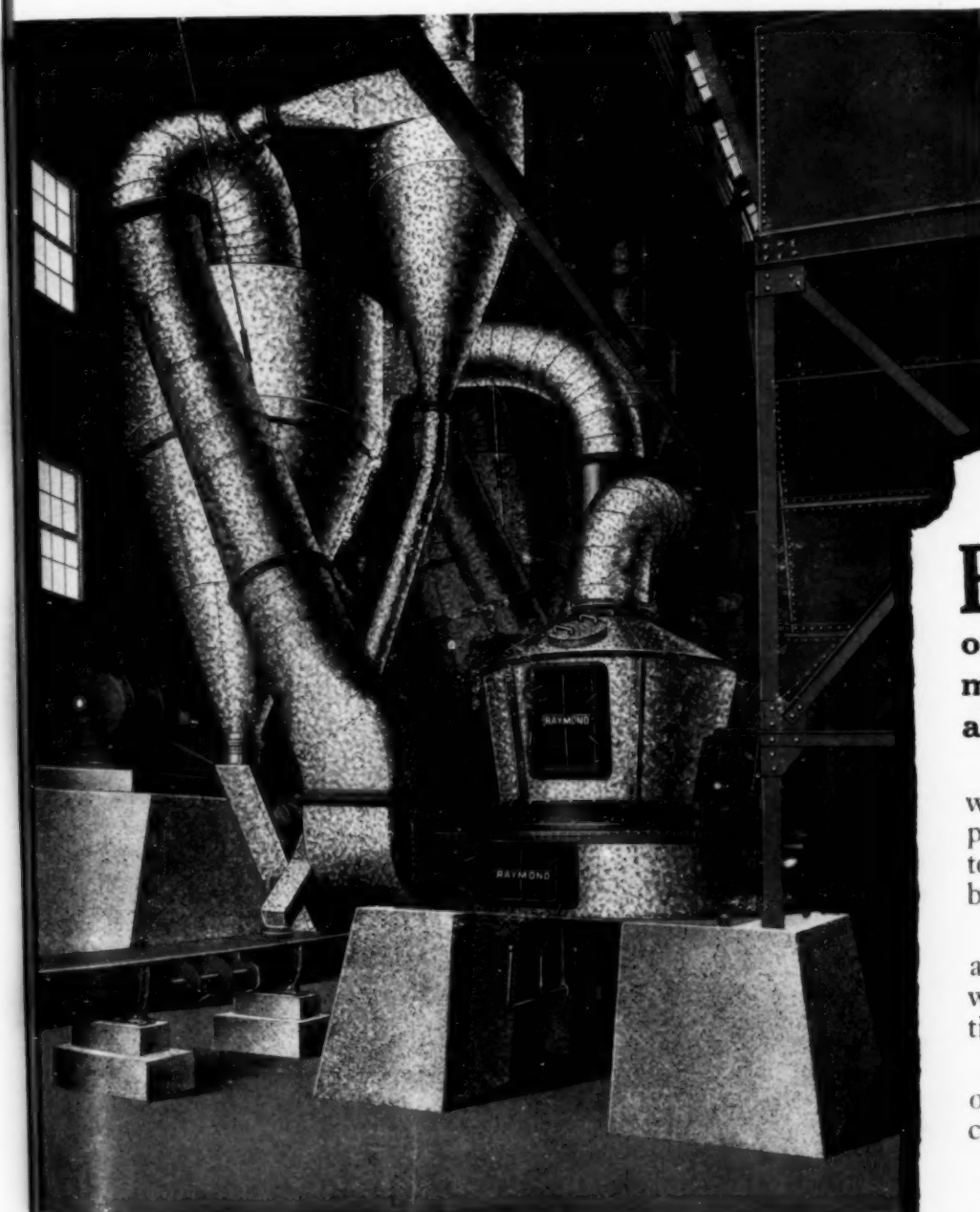
Published December 8 with Current News

CHEMICAL & METALLURGICAL ENGINEERING

New York, N. Y., Oct. 29—Nov. 5, 1919

McGraw-Hill Co., Inc.

Vol. XXI, No. 11, 25c. a copy



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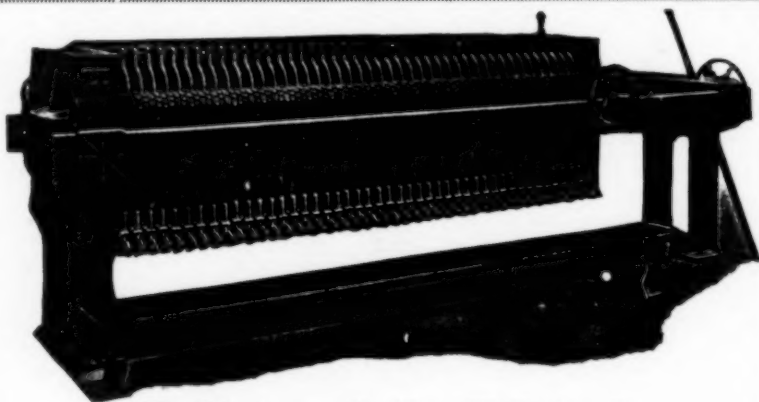
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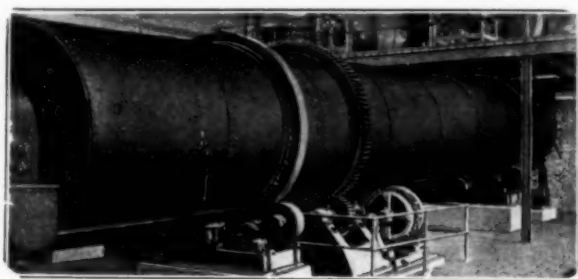
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Volume 21

New York, October 29–November 5, 1919

Number 11

An Announcement To Our Readers

ADVERSITY has its uses, which, of course, has been known since time began, if only to marshal one's friends. Our own recent engagement with the radicals, then, served to do one very fine thing, and that was to draw spontaneously from many of our readers sincere expressions of sympathy and words of cheerful encouragement in the fight in which we felt, not egotistically, that we were engaging in more than a personal struggle in a sharp engagement where it was necessary for the general welfare to demonstrate that as we intend to perform our contractual agreements with unionism, so must unionism fulfill its counter obligations.

Happily, the issue has been decided in favor of responsible unionism, but only after an immense loss in wages, income and convenience, and luckily in a manner which apparently will leave not even temporary rancor except in the case of a few irreconcilables.

The pressing problem now before us is to "catch up." CHEMICAL & METALLURGICAL ENGINEERING is the first of the McGraw-Hill papers to be returned to our own plant in New York, so that with our specially developed facilities it will easily be possible from a mechanical standpoint to be even with the date line by New Year's. Ten issues, however, will need to be mailed during the space of time ordinarily covered by five!

Two courses are open. One is to catch up as fast as possible with the delayed issues, bringing out an issue, say, every four days until we are again even with the calendar. The other alternative is to double up the editorial section for two issues, thus bringing the reader up to date.

This latter alternative, it is hardly necessary to say, is vastly more expensive, inasmuch as we, by so doing, will omit the equivalent of five complete issues of advertising. We feel, however, that it is a matter of duty on our part to bring the reader up to date with his issues just as soon as possible, and also a duty on our part to pay the cost of this strike out of our own pockets and not pass it along to the advertiser. It is the McGraw-Hill Company's cash contribution toward sane American industrialism.

In this issue, therefore, we are publishing a double section of reading matter, with the advertising section that corresponds to one issue only. It is also important to take the line at the head of this page literally; that is, the news features in this issue were compiled but a few days previous to press date. To put this idea actually in effect, all back price lists are gathered in a supplement herewith, so that we can start with a clean slate.

A Suggestive Theory on Sonims

OVER a year ago COSMO JOHNS proposed an idea regarding the genesis of oxidized compounds in steel which has apparently not been given the amount of attention it deserves as a consistent explanation of the rather meager data at hand and a basis for further research. He starts with the assumption that iron oxide has a finite solubility in liquid steel, but is virtually insoluble in the solid—in other words, the system is analogous to the well-known Cu:CuO equilibrium, where a eutectic of metal and oxide exists at the crystal boundaries. Thus in a bath of steel at its melting point there is a certain equilibrium existing in the system Fe:C:Mn:Si:FeO, which is disturbed both as to temperature and concentration as the solidification range is passed, iron oxide concentrating at the borders of the austenite crystals. But now this concentrated oxide reacts with the dissolved manganese and silicon, forming mixed silicates of iron and manganese *in situ*, thus producing solid non-metallic inclusions whose composition varies, among other factors, as the relative concentrations of silicon and manganese metal, and their affinity for oxygen.

But carbon is also present, and it is oxidized by the iron oxide as well. Thus gaseous compounds form, carbon monoxide always predominating because of equilibrium conditions at the high temperature. However, the dioxide is always present—and found, corresponding fairly closely to the volume relationship between the two oxides theoretically required by the C:CO:CO₂ equilibrium. However, methods of determining gas in steel are so far from precise that only general relationships can be inferred from currently published analyses.

The theory accords well with the general impression that low-manganese or silicon steels favor a gaseous end product and consequent blowholes, a result of gas formation in pasty material. High-manganese or silicon steels favor a larger total of solid oxidized materials; gases also form, however, and usually are found to an extent roughly proportional to the amount of sonims. An increased volume in gas is formed at a lower temperature and is retained either in solution or at high pressure at crystalline boundaries in sub-microscopic cavities.

One needs only to call to mind the troublesome "flakes" to remember how effectually a small amount of iron oxide or "oxidized impurity" deteriorates the quality of really excellent steel. Obviously, any well-reasoned contribution along the lines indicated above is a step toward the ultimate explanation of most perplexing and disconcerting heterogeneities appearing now and then in ferrous alloys.

A Scientific Union From Chicago's City Hall

SCIENTIFIC Laboratory Union No. 16986, chartered by the American Federation of Labor, comes forth with the publication of an open letter exhorting laboratory workers everywhere to secure the benefits of organization such as "the encouragement of higher degree of skill and efficiency," a reduction in hours of labor, the adoption of a minimum wage scale, and so on. The letter consigns "the false monarch" Ethics to a niche in the Hall of Fame, where in some unexplained manner "it will serve to give us a living wage consistent with the trend of modern times."

In poor English and worse logic it proceeds along the time-honored lines of labor propaganda, advancing as a clincher that "Specialists have agreed that living costs have advanced 72 per cent since 1913." Ordinarily, in comparing the trend of prices, one turns to the well-known index numbers. When expressed as percentages of the index number for 1913 these figures are quoted as follows for June, 1919, the last month available: Bureau of Labor Statistics, 326 commodities, 207; Annalist, 25 commodities, 216; Bradstreet, 96 commodities, 196; Dun, 200 commodities, 189; Gibson, 22 commodities, 212. Unfortunately the agreeing authorities—those specialists notoriously hard to bring into exact agreement—are not designated by the Scientific Laboratory Union's publicity agent; but without contending that wholesale price index numbers are representative of living cost to laboratory assistants on our part it is at least apparent how easy it is to befuddle judgment by quoting "authoritative figures" and that the agreeing specialists have overlooked a bet in their figure on the high cost of living.

Ethics, or the science of conduct in the shaping of organized existence, will hardly be recognized if we cannot expect more mature thought in the minds of scientific and educated men than has been evidenced in this case.

Industrial Conference Splits On Collective Bargaining

AS INTIMATED in these columns, and as frequently expressed at the Industrial Conference in Washington, the steel strike resolution and the one on collective bargaining proved too much for the weak cohesion of that body, and it went to pieces after both measures had been defeated. Labor stood alone in its support of the resolution to adjudicate the steel strike, being opposed by the groups representing the Public and the Employers. And on the subject of collective bargaining, each of the groups cast the sole affirmative vote on its particular form of resolution, being opposed in each case by the two other groups. An impasse being thus reached, Labor withdrew from the Conference, being led out by Mr. GOMPERS in spite of an earlier appeal from the President urging that "a happy conclusion" be reached.

It is worth while to examine a little more closely the disagreement on collective bargaining, because in the abstract that is a subject on which all the elements of the Conference were in agreement. It was in the concrete application of the principle, the machinery, the *modus operandi*, that the different groups of the Conference failed to agree. In brief, the crux of the matter was whether the unions should be the repre-

sentatives of the workers in industrial arbitration; whether employers should be required to confer with union agents only as representatives of their employees.

The resolution presented by Mr. Gompers read as follows:

"The right of wage-earners to organize in trade and labor unions, to bargain collectively, to be represented by representatives of their own choosing in negotiations and adjustments with employers in respect to wages, hours of labor, and relations and conditions of employment, is recognized."

Controversy waged about the interpretation of the phrases "in trade and labor unions," and "representatives of their own choosing," because it was urged that these would practically imply enforced recognition of the unions and enforced dealing with union agents. Compromise was sought in various amendments more broadly expressed. No one questioned the right of the workers to organize, but the Employers suggested that "shop industrial councils and other form of lawful associations" as well as "trade and labor unions" be recognized as suitable representatives of employees in collective bargaining. The Public Group suggested "associations of their own choosing" as proper mediums through which employees might negotiate with employers. But to these and other proposals Labor was adamant. Apparently nothing would be acceptable but the wording proposed by that group! It was as fine an effort to promote unionism and fasten its tenets on American industry as has ever been witnessed; and had it been successful it would have committed American industry to a narrow line of development in industrial democracy.

No sane man can oppose the principle of collective bargaining on the part of either employers or employees, or both. It involves the same principles of barter and sale that apply in everyday commercial transactions. In the old Yankee parlance it involves "swapping" one thing for another. If a "swap" is proposed, each party considers what it may gain or lose, and finally decides either to trade or not. No compulsion rests on either side, and neither has the right to force the other to trade if he doesn't want to. But—if a trade is agreed upon, the moral obligation rests upon both parties to abide by the terms of the deal and carry out the agreement. And right there is where Labor has fallen in the public esteem, for of late its contracts and agreements have been scraps of paper. That this condition is not approved by conservative labor leaders does not lessen Labor's responsibility. Rather it weakens faith in the ability of those leaders to check the effects of radical teachings, and points to the necessity of other measures if we are to escape the consequences of irresponsible leadership. In our judgment Labor was too obstinate in holding for its own language in the resolution. It refused to accept amendments or interpretations that would recognize other forms of employees' associations than trade and labor unions, and thereby lost the support of even the friendly Public Group in the Conference.

Labor came out of the Conference with less prestige than it entered. It was too combative. We recognize clearly the reasons for the fighting attitude of Labor in years past, when it was endeavoring to establish the justice and right of a day's wage and the right of association in unions. But that time

has passed. The attitude of employers in general is progressive, and the temper of the time calls for friendly conciliation and arbitration. Fundamentals of industry are more clearly appreciated now than before, and men who are willing to think can get together.

If the war taught one lesson supremely, it was that force does not get far in this generation—at least not much farther than the Marne! And if we were to suggest an idea to Labor it would be to do more thinking and less fighting.

Restoration of Foreign Exchange

IT IS a curious thing that after the Armistice the breakdown in foreign exchange was not generally foreseen. The United States was exporting a great deal more than it was importing, and borrowing by foreign countries could not continue indefinitely. Undoubtedly the bankers foresaw conditions that have since come to prevail, but certainly business men generally did not foresee. They were preaching that the opportunity must be quickly embraced for the United States to cultivate a large export trade or the opportunity would be lost. A year after the Armistice the Italian buyer has to pay more than double price for American goods, by reason of the exchange rate being so heavily against Italy.

It is not to the advantage of the United States that such conditions should exist. The extra price paid by the foreign buyer benefits no one. The whole system of exchange is a highly complicated one, and any merchandise movement that serves to increase the departure from normal in the exchange rate between two countries sends a disturbance through the whole system. It is very probable that if any expert on exchange had been asked how far exchange rates could depart from parity without breaking down the system he would have indicated limits far inside those that have been transgressed in the case of many of the rates lately current. There is, however, a breaking point. In domestic commerce a business house may suffer some impairment of credit whereby it pays a slight premium for goods it buys, or borrows money at a disadvantage, but the case does not go far until the house loses its credit altogether.

Perhaps business men were misled by the ease with which Great Britain held sterling exchange during the war. The process was simplicity itself. The rate was established and representatives of the British Government bought and sold exchange at the set rate, the British Government then borrowing from the United States from time to time such sums of money as were needed to fill the engagements. That was when Britain was at war. The process could not be continued, any more than war with its increasing dislocations could be continued forever.

Loans by the United States are named as a means of correcting the exchange situation, but the essence of such transactions must be understood. They would be medicine, not food. They would not support the countries to which they were made, but would be useful only by way of their enabling the countries to get into shape to support themselves. Bankers would make them if thereby it were certain the countries would be set on their feet.

The desideratum is that international trade be re-

stored to a normal and natural basis, whereby each country will import only what it can afford to import. The countries that have debts to outsiders cannot import much. They must export more than they import, or pay the balance in some other way. The United States was before the war a debtor nation and on account of this and other circumstances had to export more than it imported. Now the United States is a creditor nation, and also has a merchant marine, collecting freights from foreigners. It should import more than it exports or by its growing richer it would be in danger of bankrupting somebody.

The development of an import trade for the United States, however, presents a very difficult problem. The difficulty is apparent to anyone, but the difficulty is emphasized if one attempts to map out a program. One's first recourse would be to study in detail the import trade we had before the war, as that trade might represent a basis on which to build. This trade, however, presents a bewildering complication of details. For illustration, there is given below a list of the largest items of imports in the year before the war, the fiscal year ended June 30, 1914. The total imports amounted to \$1,893,925,657.

IMPORTS, YEAR ENDED JUNE 30, 1913

Hides and skins.....	\$120,289,781
Coffee.....	110,725,392
Sugar.....	101,649,375
Raw silk.....	100,930,025
Fiber manufactures.....	82,404,239
Unmanufactured rubber.....	76,162,220
Lumber.....	62,433,039
Fruit and nuts.....	53,421,258
Unmanufactured wool.....	53,190,767
New copper.....	39,551,268
Tin.....	39,422,479
Meat and dairy products.....	38,760,989
All breadstuffs.....	36,540,651
Silk manufactures.....	35,454,786
Tobacco.....	35,029,055
Art works.....	35,010,449
Wool manufactures.....	34,294,204
Laces.....	33,865,822
Sisal grass.....	25,860,729
Animals.....	24,712,111
Crude cocoa.....	20,797,790
Spirits, wines and malt liquors.....	20,347,546
Unmanufactured cotton.....	19,456,588
Nitrate of soda.....	17,950,786

One may well be dismayed by scrutiny of this list, so far as concerns its containing commodities that we may import in larger quantities so as to help the international trade situation.

In the case of most of the items we are glad to import all we can get, and in the case of many of the items it would be impossible for the outside world to increase its production.

The list, however, is illuminating in its way. For instance, it shows something that the average man would not have assumed, that we imported a greater value of crude cocoa, not yet ready to drink, than of spirits, wines and malt liquors, all ready. France has felt bad about our recently acquired dryness, but we imported two-thirds more laces than of all intoxicating beverages. France should make laces. Indeed, this little illustration furnishes the key to the whole matter.

The time was when economic policy dictated that we should import raw materials and keep our factories and workmen busy with them. Now the case is reversed and we need to import the highly manufactured goods that we have not labor supply enough to produce. We have the money with which to buy and there are many idle workmen in Europe. They need organization and incentive. Instead of sending salesmen abroad, as was urged just after the Armistice, we should send factory managers and organizers.

Readers' Views and Comments

Chemical Nomenclature and Spelling

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read with much interest the article on Beryllium, entitled "Glucinum," by J. S. Negru, in the Sept. 15 number of your journal, page 353.

Reading this article makes me wonder if it would not be possible for the chemical journals of America to get together and all use the same form of chemical spelling and nomenclature, possibly that already adopted and made official by the American Chemical Society. In this same article you spell the word "sulfur" and its derivatives with "ph"; of course, this is still quite common in this country. So far as a choice between beryllium and glucinum or glucinium is concerned, the matter, after being extensively discussed in *Science* (Dec. 9, 1904, Jan. 6, 1905, and Feb. 17, 1905), was brought up before the Council of the American Chemical Society and after an extended discussion there the Council voted almost unanimously—only one vote being in the negative—that "beryllium" was the proper term and that the Society should use it in all its publications, which it has always done since. In the first article published by Vauquelin he did not use the word "glucinum" at all, but spoke of a "la terre du Béril," which was naturally translated into German as "Berylerde" and when the material was separated later by Vauquelin when the word "beryllium" was first used, the French "glucine" was proposed by editors of the journal which published Vauquelin's article and the words "glucinium" and "beryllium" were used interchangeably in England. As the element is a metal, there can be no excuse for the word glucinum on any account, even if the root of the term now used in France is preferred. All metals should end in "ium."

But as I have said before, this has all been threshed out in arguments in *Science* as noted above. The main point that I wish to bring out is that for years now the American Chemical Society has maintained a Committee on Chemical Nomenclature and Spelling, a committee which has done hard work and which for several years co-operated with a committee of the American Association for the Advancement of Science to finally determine the procedure for the whole American Chemical Society. The Committee, after careful investigation and study, has adopted a certain form of spelling which is used in the journals of our Society. This is the only organized work done on spelling and nomenclature and should, I think, be adopted by all our chemical journals until such time as it is officially altered. Why, for example, our journals should continue the incorrect use of "ph" in sulfur simply because some bad speller put it in the English language is beyond my conception. The word comes from a Latin word which was originally spelled with an "f." Every other language in the world uses the "f" and not the "ph." Sulfur is spelled with an "f" in all chemical literature except some of that printed in the English language and for years has been so used in the journals of the American Chemical Society and also is authorized spelling in Webster's latest International Dictionary. It has been adopted by the Standard and Century Dictionaries and has been used solely by the Patent Office for some ten years back. We have too many badly

spelled words in the English language outside of chemical literature—words which have simply come into common use because certain of our early literary lights like Pope and Johnson were bad spellers. They are the abomination and stumbling block of all foreigners attempting to learn our otherwise simple language. Can't we all get together and try at least to have some common practice in the literature of chemistry?

CHARLES L. PARSONS.

Washington, D. C.

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the letter of Dr. Parsons, published above, the suggestions to use "sulfur" instead of "sulphur," and to have all the metals end in "ium" deserve no doubt all due attention, and it might be expected that we will also have soon "fosforus," "bismutium" or "bismuthium," and so forth, instead of "phosphorus," "bismuth" and so forth.

As to using beryllium and not glucinum or glucinium, I might refer to my letter published in *CHEMICAL & METALLURGICAL ENGINEERING*, Oct. 1, 1919, pp. 417-418, in which I have already mentioned the references quoted in Dr. Parsons' letter, which is dated Oct. 28, and also gave as references authorities using "glucinum" as late as September, 1919. It might help some to go back awhile and mention the following:

Roger Jones and Andrewe Palmer obtained an English patent Feb. 23, 1623, for a process of "Makeing of hard soape with a material called berilia and . . . The 'berilia' consists of the ashes of beanestrawe, peasestrawe, and of English kelpes."

Humphry Davy stated, in a paper read before the Royal Society, June 30, 1808 (*Philosophical Transactions of the Royal Society of London*, Pt. II, p. 353), when speaking about the "Enquiries relative to the decomposition of alumine, silex, zircone and glucine": "Had I been so fortunate as to have obtained more certain evidences on this subject, and to have procured the metallic substances I was in search of, I should have proposed for them the names of alumium, silicium, zirconium and glucium."

John Dalton in his "A New System of Chemical Philosophy," Manchester, 1810, uses "glucine."

William Henry in his "Elements of Experimental Chemistry," Philadelphia, 1819, states on p. 220, Vol. I: "We have no knowledge of the base of glucine. When obtained its proper demonination will be *glucinum*. The general fact of its existence is proved by igniting glucine with potassium which is thus changed into potash."

Jacob Green in his "Textbook of Chemical Philosophy," Philadelphia, 1829, states on pp. 341-342: "Glucinum was first satisfactorily ascertained by Dr. F. Wöhler, near the close of the year 1828; till then glucina, a substance first discovered by Vauquelin in the beryl and emerald, was only supposed from analogy to be the oxide of a metal called glucinum."

William Allen Miller in his "Elements of Chemistry," London, 1860, starts the section of glucinum with: "Glucinum, the beryllium of the German writers."

These few references to some of the past chemical authorities—not to mention at length practically all the authors of textbooks on chemistry published in

English—together with those referred to on p. 418, Vol. 21, of *CHEMICAL & METALLURGICAL ENGINEERING*, carry weight enough to warrant our not having to use the word beryllium when speaking about "Glucinum, the beryllium of the German writers."

J. S. NEGRU.

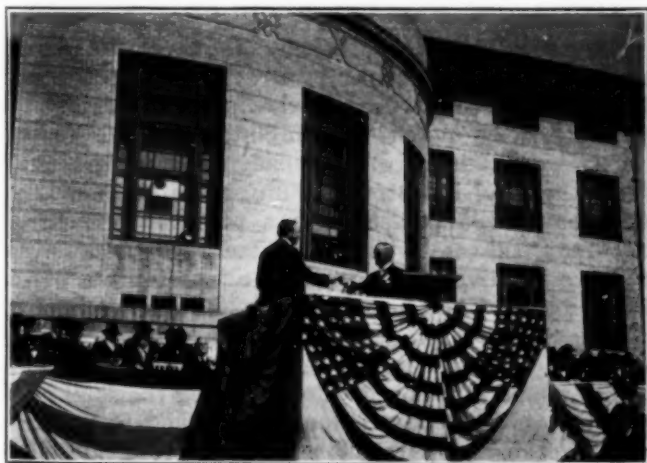
New York City.

EDITOR'S NOTE:—Our aim in publishing the article on Glucinum was to give "An introduction intended to encourage the metallurgical and chemical development of the metal, its alloys and salts." It has led incidentally to the subject of chemical nomenclature and spelling, a subject which was not as solidly settled as Dr. Parsons might think. The ruling of the Council of the American Chemical Society to use "Beryllium" seems to be as unsatisfactory to some as the ruling of the American Association on the spelling and pronunciation of chemical terms to use "Glucinum" was to Dr. Parsons.

We have given quite a wide publicity to the work and aims of the newly created International Union of Pure and Applied Chemistry. We feel that the body of scientists and industrials composing the Union will consider the importance of a standardized chemical dictionary, and that the Council of the Union, of which Dr. Parsons is a vice-president, will meet soon to take up this subject and arrive at decisions which shall prevail.

Bureau of Mines Dedicates Pittsburgh Station

Appropriate exercises for the dedication of the Pittsburgh Experiment station of the U. S. Bureau of Mines were held at Pittsburgh on Sept. 29 and 30 and Oct. 1. The building, which is a large brick structure situated in the Schenley Park district near the Carnegie Institute of Technology, was opened for inspection of laboratories and exhibits. Formal program was participated in by the Pittsburgh Chamber of Commerce, which assisted materially in securing the station for Pittsburgh. Dr. S. B. McCormick, chancellor, University of Pittsburgh, delivered the invocation. Mayor E. V. Babcock gave an address of welcome in which he commented on the important aggregation of scientific and technical institutions in the Schenley district; namely, the Carnegie Institute of Technology, the University of Pittsburgh, the Mellon Institute and the Bureau of Mines.



ASSISTANT SECRETARY OF THE INTERIOR VOGELSANG HANDING KEY OF BUREAU OF MINES BUILDING TO DIRECTOR MANNING

Response was made by Mr. Alexander T. Vogelsang, First Assistant Secretary of the Interior, who represented Secretary Lane. Governor William C. Sproul also spoke and committed himself to an effort to secure State legislation bearing on the mining industry. Mr. J. Parke Channing represented President Winchell of the American Institute of Mining and Metallurgical Engineers and spoke at length on industrial relations. Mr. Van A. Bitler spoke on behalf of the president of the United Mine Workers of America. Following these addresses, Secretary Vogelsang presented to Director Manning the key to the building.

In the afternoon the entire party was taken to the experimental mine near Bruceton, Pa., where a coal-dust explosion was demonstrated. Other demonstrations consisted of the use of liquid oxygen as an explosive; the danger of an electric current making a circuit through metal powder cans; the danger of an open-flame exploding kegs of black powder; and the use of rock dust in the prevention of mine explosions.

Features of the two following days were contests between first-aid and mine-rescue teams which had come together from all over the country.

Sixteenth General Meeting, American Iron and Steel Institute

ANYONE attending the sixteenth general meeting of the American Iron and Steel Institute at New York City, Oct. 24, would have no doubt left in his mind how the membership as there represented viewed the matter of collective bargaining with labor unions. The president, Elbert H. Gary, outlined the meetings of the Washington conference between representatives of labor, capital and the public, just terminated, and reaffirmed his stand that the employer had a right to refuse to negotiate working conditions with any workmen's representative not actually employed by him. In this stand he said he was upheld by the management of his own corporation, by the stockholders—if a volume of letters from them was representative—and by the public at large. At least the body of steel-men assembled at the Hotel Commodore adopted unanimously and enthusiastically a resolution of confidence in their president, assuring him of their hearty support and belief in the correctness of his attitude.

But business and technology evidently do not mix, for the Chair's announcement that the meeting would listen to Van H. Manning talk upon the Bureau of Mines was the signal for three-quarters of the men in the over-crowded room to bolt for the door. As one of them remarked, "I don't know anything about these things, so I'll go." The faithful few who remained, however, heard some very stimulating papers, both in morning and afternoon sessions.

Résumé of Technical Session

Dr. Manning recounted briefly the history of the Bureau, showing how its first duties of safeguarding the health of the worker and our own natural resources have led to investigations in many fields; work on suffocating gases, on safe explosives, on fuel conservation, and the various researches of the many experiment stations. Especially interesting to iron and steel men is the work at Minneapolis, confined almost exclusively to ferromanganese and deoxidizers during war times, but now reaching out into the direct

reduction of iron ore and methods of utilizing our large deposits of low-grade and high-sulphur ores.

Dr. W. E. Ruder of the General Electric Co. reviewed the situation as regards "X-Ray Examination of Metals." He noted that the opacity of iron was so high that the use of the fluorescent screen, so handy in therapeutic work, is valueless for sheets more than 0.02 in. thick; still this method was usable in some cases to examine joints in assembled pieces. Photographic plates with an intensifying fluorescent screen were necessary when thicker metals were to be examined. Short-wave-length rays (so-called "hard" rays) give the best penetration, but require a very high e.m.f. for their production. Plant limitations and available apparatus make it impracticable to X-ray steel more than 2 in. thick; this requires 2½ hr. exposure by the best tubes with 10-in. spark gaps, utilizing current at 100,000 volts. In special laboratories, equipped with higher tension currents, considerably better can be done.

However, a great disadvantage lies in the fact that the rays themselves are considerably scattered in passage through sound metal, with a resultant fogging of the negative. Small defects near the skin are therefore more often shown than deep-seated blowholes of considerable size. Forgings are even more difficult to examine than castings, since their flaws usually consist of thin cracks. Prepared cracks in metal, when photographed under best conditions and in a known position, can be distinguished when 0.02 in. thick in 1½-in. metal, or a 0.007-in. crack can be found in ½-in. metal.

X-ray examination is evidently one method of investigating changes in a test-piece without damaging it in the least. Magnetic analysis, as discussed by R. L. Sanford of the Bureau of Standards, is another such method and in addition should become extremely useful as a test for uniformity with a chosen standard. The author noted that this test was being applied to shop conditions, as a method of comparing the quality of each piece produced to that of a master specimen. However, it required special and individual study to develop methods and equipment to test various types of manufactured articles. Thus, the curve-drawing instrument for testing rails, wire, or other continuous articles of uniform cross section has been known for two or more years. Another machine for testing rings is now under development, where the torque required to spin the ring in a uniform field is measured—any non-uniformity in the force represents a corresponding non-uniformity in the metal.

ELECTRIFICATION OF REVERSING STEEL MILLS

Wilfred Sykes of the Westinghouse organization presented an interesting discussion of "The Electrification of Reversing Steel Mills," illustrated by an excellent motion picture. He noted that the development of the reversing motor had been a simultaneous achievement of American and Continental engineers, the first installation on this side having started operations 12 years ago on a 2-high plate mill at the South Works, Chicago. Robert Hobson, the Canadian, has the credit of building the first successful blooming mill drive. Twenty-six reversing mills are now motor driven in America, comprising all types of reversing stands. While the first cost is more than for a steam installation, the fuel consumption is but one-half to

one-third. This is better appreciated by one who is familiar with the huge boiler plant required by a reversing steam engine when it is stated that the electric energy consumed by the motor drive is only 2½ times that of all the auxiliaries. Electricity is certainly a more economical energy to generate in bulk; the entire mill load is such that the peak of one operation fits in between the peaks of others, thus reducing the standby capacity needed, and the overall flexibility of the plant operation in general.

OPEN-HEARTH FURNACE AND PROCESSES

A series of queries was propounded by Henry M. Howe as to the excellence of somewhat standardized ideas on the open-hearth furnace and processes, queries designed as an outline for a future discussion on this general subject. Regarding furnace construction, he wished the economic and metallurgical advantages of tilting furnaces compared to those of the stationary type. Regenerator construction seemed illogical, and especially the checker design might be improved. How much watercooling of ports is economical in order to retain their shape? Are draft fans a paying proposition? The size of furnaces should also be carefully considered as regards the saving in fuel, soaking pit volume necessary, depth of bath, and refining action at slag : iron interface.

As regards the process itself, it appears that the composition of the slag is very important as to saving in iron oxide and its effect on the bath itself. Would it be better to charge iron oxide as ore rather than as rusty scrap or producing it during melting the iron? Would there be a real net saving by charging lime instead of limestone? Additions to the metal should be discussed in detail, in the light of the reaction products, and their fusibility, coalescing power, and tendency for liquation. In this connection, American practice of casting ingots at low temperature to produce a tough sheath should be carefully compared with foreign practice of casting at high temperature, allowing better liquation of impurities. Basic and acid processes should be discussed under truly comparable conditions, while the method of making steel in the ladle versus making it in the furnace should be argued at length. Compound processes and their relative advantages should also be considered in such a symposium.

TEMPERATURE MEASUREMENTS IN STEEL FURNACES

"Temperature Measurements in Steel Furnaces" was the subject of a paper by Dr. A. K. Burgess of the Bureau of Standards. Reviewing the history of pyrometry, he noted that high-temperature instruments were primarily developed following a request from the steel industry, but unfortunately, now that they have been perfected to a point of remarkable accuracy and convenience, the steel companies do not seem to be alive to the commercial possibilities of the instrument. Thus, practically instantaneous temperatures can be taken at 5-sec. intervals to an accuracy of 5 deg. at 1500 deg. C. Yet practically all the published temperature observations during the steel melting process have been taken by independent research organizations or pyrometer manufacturers. What is now needed is a study of the furnace, bath, and flame temperatures throughout the entire steel-making cycle co-ordinating temperature with time, and chemical

and physical changes in the slag and metal. Such information should be invaluable, not only to theoretical but to practical metallurgy.

MANUFACTURE OF INGOTS FOR LOCOMOTIVE TIRES AND ROLLED WHEELS

Lawford H. Fry, of the Standard Steel Works Co., discussed "The Manufacture of Ingots for Locomotive Tires and Rolled Wheels." His company has reverted to the earlier practice of casting individual ingots for each wheel or tire, weighing from 250 to 1900 lb. They found great difficulty in making these small ingots sound, free from blowholes and with no appreciable pipe, yet they continued their efforts, since success meant a reduction in scrap and crop ends of perhaps one-half. Steel, in the first place, must be properly made, and evolve just enough gas to counteract the contraction on cooling, and yet not enough to cause a rise in the top surface. The mold design is important; they use an octagon ingot with straight sides, whose height is from 60 to 100 per cent of the diameter across flats. The mold itself must be thick-walled at the base to cause rapid chilling at that point. Topping material thrown on the liquid metal is a very important detail. This so-called "pipe-eliminator" should not carburize the metal appreciably, but should be finely divided for blanketing effect, containing enough volatile for ready ignition, yet enough slow-burning fixed carbon to keep the top hot, and sufficient ash to separate metal and carbon with little delay.

In pouring these small molds, they are first ranged on the pit floor in 5 long rows, spanned by a gantry. A 50-ton ladle on this gantry fills two molds to a chalk mark simultaneously through two bottom nozzles, then the ladle is moved to each of the four remaining rows before the gantry shifts its position. Quick and extremely skillful work is evidently necessary.

Program American Institute of Chemical Engineers

Twelfth Annual Meeting, Dec. 3-6, 1919, Savannah, Georgia. Headquarters—Hotel DeSoto.

WEDNESDAY, DEC. 3

Meeting at Hotel DeSoto

- 9:30 A.M.—Address of welcome by Hon. Murray M. Stewart, Mayor, City of Savannah.
 Response by President Little.
 Business session.
 Canvass of ballots for officers
 Reports of officers and council.
 Reports of committees.
 10:30 A.M.—Reading of papers.
 Report of committee on chemical engineering education and discussion of Dr. Charles E. Mann's report on a study of engineering education,
 Prof. J. R. Withrow
 Development of Some Southern Industries,
 R. K. Meade
 Accident Prevention in the Mill.....H. K. Moore
 Illustrated by lantern slides.
 Developments in Chemical Engineering,
 A. E. Marshall
 12:30 P.M.—Auto trip seeing Savannah and vicinity, with oyster roast and barbecue at Bethesda.

8:00 P.M.—Meeting at Auditorium.

Reading of papers.

Address by President Little—Chemistry and the South.

History and Development of the Cottonseed Oil IndustryDavid Wesson
 Illustrated by lantern slides.

THURSDAY, DEC. 4

9:30 A.M.—Steamer trip on Savannah River and Harbor. Steamer leaves Bull St. at 9:30 A.M. The following plants will be visited: Shipbuilding yards, cotton compressing warehouses, paper and pulp mill operating on Southern pine, using sulphate process. Diamond Match Co. Luncheon served on steamer.

8:30 P.M.—Russian Symphony concert and Emma Roberts, contralto, at the Auditorium.

FRIDAY, DEC. 5

Meeting at Hotel DeSoto.

- 9:30 A.M.—Business session.
 10:00 A.M.—Reading of papers.
 Absorption Tower Packing Resistance to Gas Flow,
 F. C. Zeisberg
 Illustrated by lantern slides.
 An Analysis of the Explosion Process of Recovery of the Soda Salts from Black Liquor....H. K. Moore
 Recovery of Pyridine Bases at By-Product Coke Ovens.....F. E. Dodge and F. H. Rhodes
 Double Pipe Heat Exchangers....George A. Richter
 The Phosphate Problem.....Wallace Savage
 12:30 P.M.—Luncheon.
 2:00 P.M.—Auto trip to plant of Southern Cotton Oil Co., including inspection of crude cottonseed oil mills, preparation of lard compounds and hydrogenation of oils, and electrolytic plant, and a visit to the fertilizer plant of the American Agricultural Chemical Co. The manufacture of sulphuric acid by the chamber process and phosphate, as well as mixed fertilizer, will be shown.
 7:00 P.M.—Subscription dinner at Hotel DeSoto.

SATURDAY, DEC. 6

9:00 A.M.—Special trips for small parties to various points of interest will be arranged.

LADIES' PROGRAM

WEDNESDAY, DEC. 3

- 11:00 A.M.—Meet with reception committee at Hotel DeSoto.
 12:30 P.M.—Auto trip seeing Savannah and vicinity, with oyster roast.
 8:00 P.M.—Meeting at Auditorium.

THURSDAY, DEC. 4

- 9:30 A. M.—Steamer trip on Savannah River and Harbor. Steamer leaves Bull St. at 9:30 A.M. Luncheon served on steamer.
 8:30 P.M.—Russian Symphony Concert.

FRIDAY, DEC. 5

- 12:30 P.M.—Luncheon.
 2:00 P.M.—Auto trip to plant of Southern Cotton Oil Co. and a visit to the fertilizer plants of the American Agricultural Chemical Co.
 7:00 P.M.—Subscription dinner at Hotel DeSoto.

Dr. R. B. Moore Appointed Chief Chemist of the Bureau of Mines

DR. CHARLES L. PARSONS, chief chemist and chief mineral technologist of the Bureau of Mines, Department of the Interior, has tendered his resignation, effective Nov. 1, to take up work as a consulting chemist in Washington and to give more time to the affairs of the American Chemical Society, of which he is secretary.

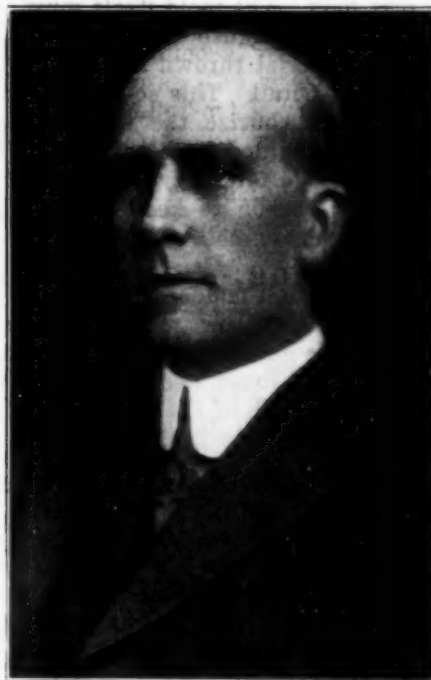
Dr. Parsons was appointed chief chemist of the Bureau of Mines in 1911, going to Washington from New Hampshire College, where he was director of the chemical department. He immediately initiated important researches and sought to show how the results of scientific inquiries could be applied to methods of producing and utilizing minerals. One of his first undertakings after assuming general supervision of the work on mineral technology was the prepara-

and nitrates by synthetic methods. In this he was eminently successful, as the methods and apparatus developed have no equal in this country or in Germany for low cost of installation, high efficiency, and cheapness of product. In connection with his work on nitrates, Dr. Parsons was sent to Europe by the War Department in the fall of 1916 to study the problem of nitrogen fixation. The report he made on his return was used as the basis of the extensive program subsequently carried out by the Government in its nitrate plants. Dr. Parsons, however, has consistently advocated the Haber, or synthetic ammonia, process for producing nitrates as opposed to the arc, or cyanamide, process.

Late in 1917, at the request of the War Department and under a co-operative arrangement between it and the Bureau of Mines, Dr. Parsons undertook the designing and construction of a plant for the manufacture of sodium cyanide to be used as a basic material in the manufacture of certain war gases. Under an



DR. CHARLES L. PARSONS



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DR. R. B. MOORE

tion of a report on mineral wastes. (See U. S. B. M. Bulletin 42.) In connection with this general view of the mineral industries Dr. Parsons took up the study of fuller's earth and its use in refining oils. Since the publication of his results in 1913 in Bulletin 71 of the Bureau of Mines, the utilization of American fuller's earth has largely increased.

Dr. Parsons next gave his attention to radium, its recovery from its ores, and its use in the treatment of disease and in the investigation of physical and chemical laws. (See U. S. B. M. Bulletin 104.) Incidental to his work on radium Dr. Parsons personally devised in the laboratory and put into plant operation a method of producing black oxide of uranium and sodium uranate, which reduced the cost of making this substance from 75c. to less than 10c. a pound.

When early in 1916, as a result of the war in Europe, a shortage of Chilean nitrates confronted American manufacturers of fertilizers and explosives, Dr. Parsons gave attention to the production of nitric acid

allotment of \$2,800,000 from the War Department, this plant was erected at Saltville, Va., within 10 months from the day engineering work began, and was completed eight months after construction started. For work on this plant the War Department assigned 21 officers and 350 men to be under Dr. Parsons' direction. The plant functioned well from the start and produced cyanide, under war-time conditions, at a cost of 20c. a lb., or two-thirds of the lowest price at which cyanide could be purchased in open market.

After the United States entered the war, Dr. Parsons served on a number of Government boards. He was a member of the Nitrate Commission throughout the war, a member of the advisory board on war gases, chairman of a joint committee on the use of zirconium in steel, and was constantly consulted by the War and Navy Departments on many important problems. He organized and completed, with the aid of the Bureau of Mines and the American Chemical Society, a census of the chemists of the country, thus

making their mobilization easy. The Chemical Warfare Service was, in a sense, the outgrowth of this undertaking. The Ordnance Department of the Army obtained most of its chemical personnel from this source. As an outcome, more than 400 chemists were detailed for chemical work during the war.

Dr. Parsons was recently selected vice-president for America of the International Union of Pure and Applied Chemistry. He has been Secretary of the American Chemical Society since 1907, the Society increasing from 3300 to 13,700 members during that period.

Dr. R. B. Moore, who succeeds Dr. Parsons as chief chemist of the Bureau of Mines, has been known to the scientific world here and abroad for many years past by his important works, especially on radio-activity, rare gases and rare metals. He first became a Government official in 1911, when he resigned the position as professor of chemistry at Butler College, Indianapolis, Ind., to accept the position as assistant chief of the division of chemical and physical investigations, U. S. Bureau of Soils, Washington, D. C., but remained only one year, being transferred to the U. S. Bureau of Mines in 1912 as physical chemist in charge of the chemistry and metallurgy of rare metals, with headquarters in Denver. Three years ago these headquarters were transferred to Golden, where the

work has been continued in co-operation with the Colorado State School of Mines.

Dr. Moore's most important contributions to science are: An investigation of the heavy constituents of the atmosphere in order to see whether any new elements exist heavier than xenon. This work was done in Sir William Ramsey's private laboratory with Sir William. A determination of the densities of krypton and xenon. An investigation (with Herman Schlundt) of the radio-active properties of the waters of the Yellowstone National Park, in order to see whether localized quantities of radio-active material might be responsible for the thermal activity. He helped in the development of the potash resources of the country. He was directly in charge of the radium work of the Bureau of Mines and of the radium plant in Denver with which the Government produced about a million dollars worth of radium during its experimental work. He was in general charge during the war of three experimental helium plants operated under the control of the Bureau of Mines, and of the helium research laboratory. In addition he is the author of various papers in connection with radio-activity, the rare gases, and rare metals.

Judging from his past activities we can feel confident that he will fulfil ably and to the satisfaction of all his important functions and tasks.

Chicago Meeting, Electric Furnace Association

THE Electric Furnace Association, which met in Chicago Sept. 22, brought together some of the foremost electric steel men of the United States and Canada. The purpose of the Association is to bring out the superior quality of products made in the electric furnace. An interesting discussion of this subject occurred. The Association is the outgrowth of a meeting held in New York last April, which was attended by electric furnace men and at which time it was recognized that there was a great need for closer co-operation among the electric furnace designer, the power engineer and those who operate electric furnaces. The Association is not an offshoot of any other society, and its policy will be to co-operate with all other societies and associations that are interested in electric furnaces or the products of electric furnaces.

BETTER STEEL AND GREATER SAFETY THE DEMAND

There were about sixty present at the meeting. H. C. Weidenthal read a paper in which he pointed out the great demand for better steel in the automotive industry and indicated the increased demand for electric steel in that field. He recited the great need for greater factors of safety in the vital parts of automobiles, trucks and tractors and showed that the electric furnace would be called upon to supply steel of the proper quality.

In response to a demand for data on electric furnace products the Association has gathered together some information in regard to the high quality of electric steel and issued it in the form of a booklet. Those who attended the meeting commended this effort, and quite a large number of the booklets were requested by those present. In addition to data on quality, the booklet

also contains some statistics on the growth of electric steel production.

A permanent organization was effected and the following officers were elected:

President, Acheson Smith; vice-presidents, C. H. Booth and W. E. Moore; secretary, C. G. Schluederberg; treasurer, F. J. Ryan. The address of the executive office of the Association is Post Office Box 616, Niagara Falls, N. Y.

The next meeting of the Association will probably be held next spring in conjunction with some of the national technical societies, and it is probable that a symposium on the subject of power for the electric furnace will be the principal feature of the meeting. This will give an opportunity for the power engineer and the electric steel men and others operating electric furnaces to discuss thoroughly the power-service problem of the electric furnace. Although the present meeting was largely devoted to electric steel, it is the intention of the Association to take up the subject of non-ferrous metals and other materials made in the electric furnace.

SOME IN ATTENDANCE

Among those who attended the meeting were L. E. Howard, of the Simonds Manufacturing Co.; L. M. Reed, Haynes Stellite Co.; A. C. Jones, of the Electric Steel Co., Chicago; W. F. Graham, of the Spicer Manufacturing Corporation; E. S. Gardner, Illinois Steel Co.; Edward T. Moore, Halcomb Steel Co.; F. W. Chapman, of the Standard Steel Castings Co.; J. M. Blake, American Manganese Steel Co.; A. Trevor Jones, American Steel Foundries; A. H. Miller, Midvale Steel & Ordnance Co.; A. U. Tirbutt, Manitoba Steel Foundries, Ltd.; Mr. Starr, Pattibone Mulliken Co., of Chicago, and many others interested in the electric steel industry.

Philadelphia Meeting, Institute of Metals

A Full Synopsis of Several Important Groups of Papers, on the Physical Properties of Zinc and Nickel, on the Constitution and Heat Treatment of Duralumin, on the Manufacture of Special Wire for Electrical Purposes, and on Physical Properties of Gun Metal

A WELL attended meeting of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers was held, as is the custom, in conjunction with the American Foundrymen's Association. Several important groups of papers were presented, and between meetings the members were entertained by excursions to Hog Island, the Baldwin Locomotive Works, local foundries or in viewing the many shrines of Revolutionary days. In connection with the joint meeting, the annual exhibition of foundry equipment was held at the Commercial Museum, which proved to be an admirable display in all respects. One was chiefly struck by the showing of machine shop tools, both in number and variety, ranging from a simple drill press to the most intricate automatic machine for a half-dozen different simultaneous operations—a machine one would scarcely expect to find in an ordinary foundry.

PHYSICAL PROPERTIES OF NICKEL

A valuable compilation of information on the "Physical Properties of Nickel" was presented by J. F. Thompson in a paper prepared with the collaboration of the late David H. Browne, of the International Nickel Co. They emphasize that "nickel" is a rather flexible term, denoting a metal whose physical properties are widely influenced by its composition and treatment, and being exceedingly difficult to prepare in a pure state. A brief résumé of metallurgical methods is given, further emphasizing the fact that results reported for "nickel" may refer to one of five different classes: sponge, Mond process, cathode crystals, Orford process, or malleable nickel.

Nickel itself melts at 1451 deg. C., has a magnetic transformation like iron, but no other allotropic modifications. The loss of magnetism occurs at 340 deg., but is by no means abrupt. It absorbs carbon by cementation, the carbide Ni_3C acting very much like cementite, in that it forms a eutectic at 1328 deg. C., and deposits graphite readily. Graphite is deleterious, but the carbide very beneficial in increasing hardness and strength. Manganese is purposely added up to 2 per cent to increase the fluidity and ease of working. Iron less than 1 per cent, silicon less than 0.25 per cent and cobalt up to 1 per cent do not harm nickel, but sulphur should be held as low as possible. Nickel may be welded electrically. If a melt of nickel is vigorously stirred by a stick of magnesium plunged entirely beneath the surface, it will be free from gaseous blow-holes and can be worked hot or cold. Hot shortness occurs above 1200 deg. C. Proper annealing range is from 750 to 900 deg. C., but one should be careful not to overheat, and to use sealed boxes with a reducing atmosphere. Oxide is removed by pickling only with great difficulty by sulphuric and chromic acid at 70 deg. C.

From the wealth of numerical data the following are selected:

Analysis:	A Shot	X Shot	Electrolytic	Malleable A Grade	High-Manganese Malleable
Ni + Co.....	98.4	98.9-99.0	99.8	98.9-99.0	96.5 to 97.0
Fe.....	0.6	0.45-0.55	0.15	0.50	0.5 to 1.0
Cu.....	0.25	0.15-0.25	0.05	0.18	0.20
C.....	0.5	0.18	None	0.10	0.20
Si.....	0.25	0.15	None	0.10-0.20	0.1 to 0.2
S.....	0.06	0.035	None	0.025	0.035
Mn.....				0.20-0.35	1.5 to 2.0

Physical properties:	Annealed	Cold Rolled
Yield point.....	20,000-30,000	90,000-110,000
Ultimate.....	60,000-90,000	100,000-120,000
Elongation in 2 in.....	40-50	15-20
Reduction.....	45-55	40-50

Atomic weight (oxygen 16).....	58.69
Specific gravity.....	8.84
Specific heat:	
from 0 to 230 deg. C.....	0.10836 + 0.0000447 t.
from 230 to 400 deg. C.....	0.1835 + 0.000564 t. + 0.000014 t ²
from 400 to 1150 deg. C.....	0.099 + 0.00006175 t.
Latent heat of fusion.....	68 kg.-cal. per kg.
Latent heat absorbed at magnetic transformation.....	4.64 kg.-cal. per kg.
Thermal conductivity.....	0.14 c.g.s.
Electrical resistivity of purest nickel.....	6.4 microhm per cu. cm.
Electrical resistivity of Grade A malleable.....	64 ohms per mil-ft. at 24 deg. F.
Temperature coefficient.....	0.0023 per deg. F.
Coefficient of expansion up to 300 deg. C.....	(1280 + 0.75 t + 0.0035 t ²) × 10 ⁻⁶

ROLLED AND DRAWN ZINC

Professor C. H. Mathewson of Yale University and C. S. Trewin and W. B. Finkeldey of the New Jersey Zinc Co. presented an extensive paper covering "Some Properties and Applications of Rolled Zinc Strip and Drawn Zinc Rod," in which they presented a quite complete view of the subject difficult to abstract in small space. At the outset it should be pointed out that ordinary tensile tests on zinc are somewhat difficult to interpret, since the metal fails at a lower load than the maximum; therefore the rate of loading has much to do with results. Test specimens also show a permanent set under small loads, which increases with a repetition of the same load, consequently there is no possibility of computing a true modulus of elasticity—the substance does not obey Hooke's law.

Viewed in the light of the amorphous theory, as recently enunciated by Jeffries,¹ the temperature of equal cohesion between amorphous and crystalline phases of purest zinc (0.004 per cent Pb, 0.005 per cent Fe) is in the neighborhood of 40 deg. C. That is to say, if this metal is rolled at temperatures somewhat above 40 deg., it will spontaneously recrystallize during grain deformation, in which case there is no hardening due to working. In fact, strain hardening induced by working at temperatures of zero deg. and lower is not permanent unless the metal is permanently refrigerated. If the amorphous phase in pure zinc at room temperatures is conceived to be somewhat plastic, the fact that this metal yields more readily to slowly than to rapidly applied stress (like pitch or hot glass) can be explained. Practically all alloying metals raise the equi-cohesive temperature of zinc and stiffen the amorphous phase even when added in tenths of a per cent. Thus sheet rolled from common spelter can be raised from 20,000 to 40,000 lb. per sq.in. by strain hardening, the rods

¹Bulletin, A.I.M.E., No. 146, p. 575 (February, 1919).

are much stiffer under slowly applied loads, and more than a week at 100 deg. C. is required for a full anneal.

The above remarks make clear the peculiarities in rolling-mill practice. Starting with a coarsely crystalline brittle slab with very low strength, a reduction of 50 per cent at a temperature of 150 to 100 deg. C. will produce a bar with an ultimate strength of 18,000 lb. per sq.in. and an elongation of 50 per cent. Theoretically, these physical characteristics are due to a fine crystalline structure, the cleavage surfaces of the individual grains—through which fracture passes—being supported by the intergranular plastic amorphous material and by their own dissimilar orientation. Rapid grain growth prevents much change in physical properties up to a reduction of 90 per cent. Later careful rolling at lower temperatures will produce a harder material, increasing the ultimate to 30,000 lb. and decreasing the elongation to 40 per cent.

Annealing practice again is quite distinctive. As usual, the grains grow upon annealing strained specimens—larger grains result from a higher (or longer) anneal. Twinned structure, so common in brass, is absent, although moderate strains cause narrow blocks of material in the grain to change in orientation, this being a form of mechanical twinning. When annealing hard drawn zinc at low temperatures, there appear to be few centers of recrystallization active; the result is that if time be given all distorted grains will be absorbed into a few coarse crystals. At higher temperatures, more nuclei are present, and the result is a finer grain.

The phenomena just described are quite in line with Jeffries' principal generalizations dealing with selective growth. Thus, the coarsest grains are found at an early temperature of recrystallization or in the equiaxing range, and when the equiaxing range is passed rapidly, as must be the case when the samples are dipped directly into an oil bath at a high temperature, smaller grains are formed.

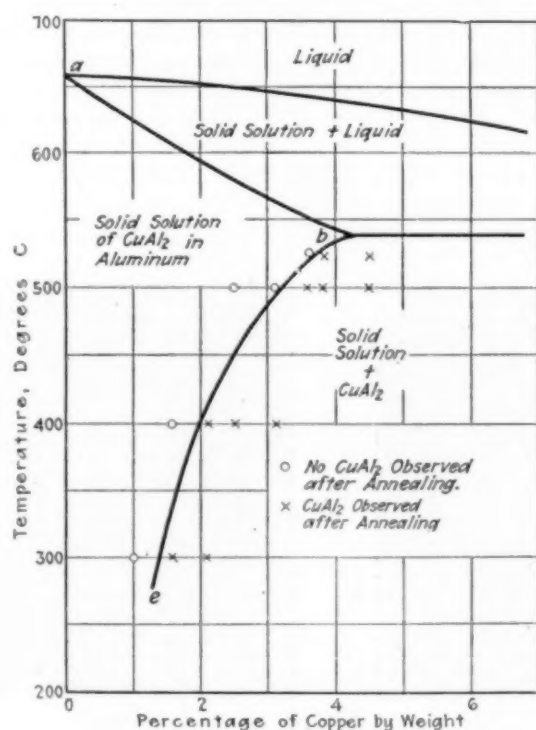


FIG. 1. PORTION OF THE EQUILIBRIUM DIAGRAM OF THE Cu-Al ALLOY SERIES SHOWING THE SOLUBILITY CURVE Cu-Al₂ IN ALUMINUM

Medium hard-drawn zinc upon reheating gives about the same results, although the selective growth of recrystallized grains does not start so soon. Once started, growth is rapid until recrystallization is complete, then a very slow growth ensues on continued anneal. Soft rolled material on annealing merely absorbs the smallest particles into their neighbors.

In addition to this general discussion the authors publish a wealth of experimental data in tabular and graphical form. In their work they developed a dynamic cupping machine to test the availability of a sheet to a drawing operation. The ordinary slow-action test for ductility gives a fictitiously high number of merit for hard strip zinc, owing to its plasticity under slowly applied loading. Actual plant operations are performed with considerable speed, however, and dead soft zinc under such impact test is practically unaffected by the speed of working, giving values about midway between hard and annealed 70 : 30 brass.

DURALUMIN

A very notable series of four papers on aluminum-rich alloys with magnesium and copper were presented by Dr. P. D. Merica and Dr. Zay Jeffries and their associates. These light, strong alloys have become quite well known within the past ten years under the name of duralumin. They are capable of rolling and forging, and under proper heat treatment will develop quite remarkable properties, chief of which is the progressive hardening which takes place at room temperatures following a quenching.

METALLOGRAPHY

In the first of these, P. D. Merica, R. G. Waltenberg, and J. R. Freeman of the Bureau of Standards present the results of studies on the solubilities of certain metals and their compounds in nearly pure aluminum in a paper entitled "Constitution and Metallography of Aluminum and Its Light Alloys With Copper and Magnesium." The study was complicated by the fact that 100 per cent aluminum metal is at present unavailable (although the Bureau of Standards is now well along toward its production in quantities sufficient for investigative purposes), commercial aluminum containing as much as 0.2 to 0.5 per cent each of iron and silicon. Copper-aluminum alloys have already been shown to develop a eutectic between CuAl₂ and Al containing about 32 per cent copper by weight and melting at 540 deg. C. Chill-casting even low-copper alloys gives a non-homogeneous, mottled structure when examined under the microscope; consequently annealing experiments by the authors were used to develop the limits of solid solution of CuAl₂ at equilibrium, as shown in Fig. 1. Within the limits of solid solution the microscopic appearance at 300 diameters is a uniform fine grain (sorbite) due to impurities contained in the available aluminum; but just beyond the line *be*, excess CuAl₂ appears as white rounded particles in this ground mass (etching in 0.1 per cent NaOH plus 10 per cent alcohol). This precipitation and segregation into microscopic particles requires very slow cooling from 500 deg., and as much as 1 per cent magnesium was found to have no influence on the solubility curve.

Again, in regard to the binary system aluminum-magnesium, the authors note that previous researches show a eutectic between Al and Mg₂Al₃ melting at about 460 deg. C. and containing 36 per cent Mg. A set of annealing experiments similar to those with low-copper

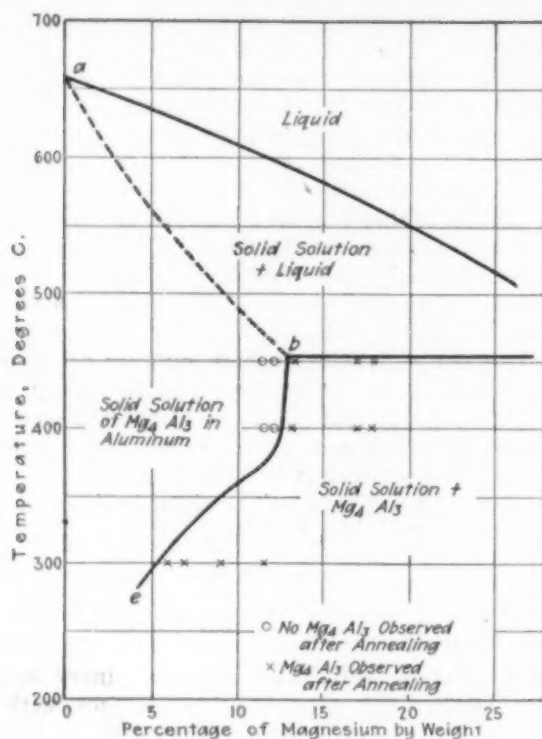


FIG. 2. PORTION OF THE EQUILIBRIUM DIAGRAM OF THE Mg-AL ALLOY SERIES SHOWING THE SOLUBILITY CURVE Mg_2Al_3 IN ALUMINUM

alloys now establishes the solubility curve *be* of Fig. 2. After an etching with 5 per cent NaOH solution, Mg_2Al_3 shows as clear islands scarcely differentiated from the ground mass except by a boundary line (Fig. 3). The few dark particles in this micrograph have an easily distinguishable and characteristic deep blue color, its amount increasing slowly if at all with an increase of magnesium content beyond about 1 per cent. This is believed to be Mg_2Si , a well developed compound in that binary system, or a silicate or complex compound containing Mg, Si, Fe and Al.

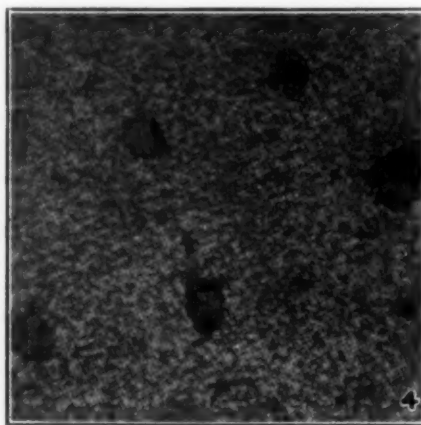
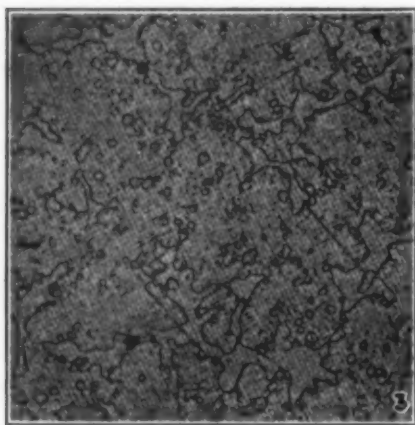
Guyer, studying the iron-aluminum system, has already shown that the compound $FeAl_3$ forms a eutectic with aluminum at 649 deg. C., containing between 1 and 2 per cent iron. Observations on commercial aluminum, containing as low as 0.15 per cent iron, show a large amount of light bluish constituent, both in the form of distinct islands and scattered uniformly through the aluminum grains (Fig. 4). It can be differentiated

from $CuAl$, by its darker color, also in the fact that it turns brown on long etching with dilute alcoholic NaOH solution (Fig. 5). Darker markings ordinarily appear in the eutectic islands when silicon reaches 0.20 per cent, corresponding to the simultaneous appearance of a constant arrest at 610 deg. C. This constituent X is possibly a compound containing silicon and iron, since it is known that Si and Al alone form no compounds, but a eutectiferous series with a minimum melting point at 576 deg. C. and 15 per cent silicon. An additional arrest in the cooling curves at 576 deg. C. appears only with relatively high amounts of silicon alloyed with commercial aluminum. Owing to the facts that $FeAl_3$ is so insoluble in Al and that the best obtainable aluminum will have a few hundredths per cent of iron, the metallic crystals forming the ground mass of all aluminum specimens will appear granulated by the ever present iron eutectic.

LOW TEMPERATURE HARDENING

With the above information as to the constitution of duralumin well in hand, it is possible for Merica, Waltenberg and Scott to present a reasonable explanation of its hardening on low-temperature annealing in their paper on "The Heat Treatment of Duralumin." No difference in microstructure can be observed after aging, but thermal analysis gives a little light. An irreversible evolution of heat occurs at from 250 to 275 deg. C. in samples which have been quenched but not aged, which phenomenon is missing from annealed or aged metal; evidently stable phases have been formed by time and temperature, missing in the quenched metal.

It has been shown by many previous investigations, and confirmed by the authors, that aluminum undergoes no transformation in the solid state between ordinary temperatures and its melting point. No other phase changes would occur in the main mass of duralumin, (the grains of solid solution), therefore, except those of solution or precipitation of $FeAl_3$ of the X compound, of $CuAl$, of Mg_2Al_3 , or of Mg_2Si within the grains. Commercial aluminum, which contains the same amounts of $FeAl_3$ and of the X compound as does duralumin, is not altered by heat treatment as is duralumin, nor does it show a reverse heat effect upon heating as does the latter. This heat effect must, therefore, be due to the precipitation either of $CuAl$, Mg_2Al_3 , or Mg_2Si . But the alloys containing only magnesium, in amounts up to 3 per cent, also do not harden upon aging. There remains



FIGS. 3 TO 5

Fig. 3. Mg-Al alloy, annealed 20 hr. at 400 deg. C and then quenched. Mg 17.1 per cent. Etched with 5 per cent NaOH. X 200. Fig. 4. Commercial aluminum (Si 0.20 per cent, Fe 0.50 per cent), showing eutectics of $FeAl_3$ and of constituent X. X 1000. Fig. 5. $FeAl_3$ eutectic, and fine particles throughout groundmass. X 1285. Mg 1 per cent, Cu 1.6 per cent, Fe 0.3 per cent, Si 0.26 per cent.

only the precipitation of CuAl_2 , with which to explain this heat effect.

The theory is the more reasonable when found to check with the observed work on solubility of CuAl_2 in aluminum. Hardening or aging is therefore ascribed to the precipitation of the then insoluble CuAl_2 from its solid solution, temporarily held in unstable equilibrium by rapid cooling. However, even on aging at 100 deg., the temperature is so low that molecular migration and coalescence of the precipitated particles to a microscopic aggregate is impossible; consequently aged and freshly quenched specimens show no marked difference optically. The phenomenon is in fact quite similar to the hardening on low temperature anneal of some high-carbon or tungsten steels by precipitation of highly dispersed cementite from austenite. Aluminum-zinc and aluminum-magnesium-nickel alloys also harden upon aging—in each case a demonstrated decreasing solubility at lower temperatures of a constituent is probably responsible. In duralumin, the presence of magnesium, although in itself not capable of giving the aging effect, accelerates the influence of copper, possibly by lowering the melting temperature of the FeAl_3 eutectic, which often wholly encloses masses of CuAl_2 (Fig. 5), in this manner indirectly allowing the latter to diffuse more readily into the aluminum.

Thermal analysis of duralumin as a whole is quite complicated, since six probable binary eutectics occur, to say nothing of possible more complex aggregates.

$\text{FeAl}_3 + \text{Al solid solution}$	Deg. C.
$\text{Si} + \text{Al}$	640 to 650
$\text{X} + \text{Al solid solution}$	570 to 580
$\text{CuAl}_2 + \text{Al solid solution}$	610
$\text{Mg}_2\text{Si} + \text{Al solid solution}$	520 to 540
$\text{Mg}_2\text{Si} + \text{Al solid solution}$	450
Mg_2Si	440

Temperatures are approximate and observed in the presence of both FeAl_3 and X eutectic.) Consequently thermal analysis is somewhat complex, as is shown in

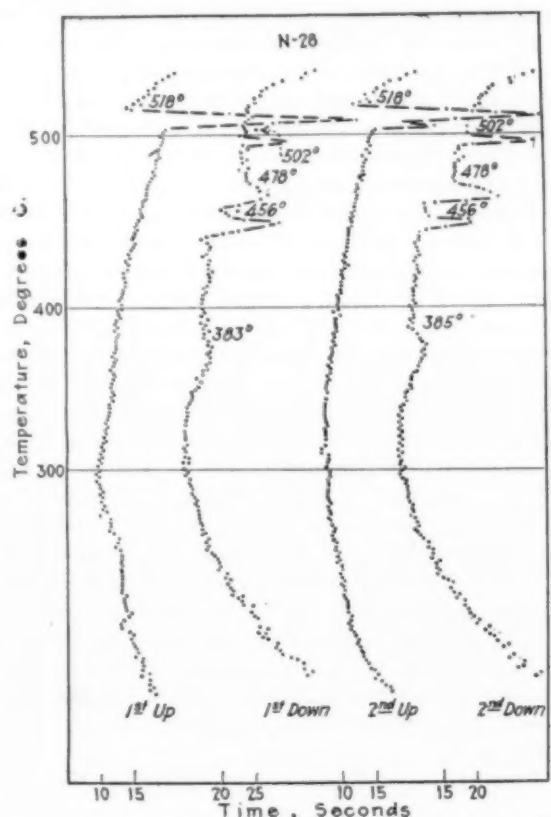


FIG. 6. HEATING AND COOLING CURVE OF N-28 (Cu 4.98 PER CENT, Mg 2.41 PER CENT)

Fig. 6, this cycle repeating itself indefinitely. On first cooling a solid solution of CuAl_2 first crystallizes, these crystals forming nearly the whole alloy and leaving only thin films and drops at the crystal boundaries. The walls of these cavities are then lined by the FeAl_3 aluminum solid solution eutectic on decreasing tem-

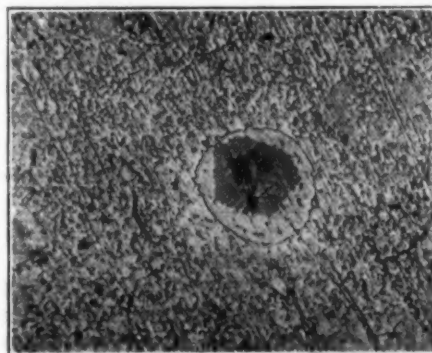


FIG. 7. SPECIMEN OF N-28 CONTAINING Cu AND Mg, SHOWING ISLAND OF Mg_2Si (DARK) WITHIN ONE OF CuAl_2 (WHITE). X 650

perature, until at about 500 deg. the binary eutectic CuAl_2 aluminum solid solution crystallizes with the remainder of the first eutectic. Even later at 478 and 456 deg. Mg_2Si and perhaps some MgAl solidify in the remaining voids. Microscopically the result is as shown in Fig. 7, where the phenocryst is probably "negative CuAl_2 " rather than "positive Mg_2Si " (the striations on its face at least are not parallel to its edges). On reheating, however, the surface of contact between Mg_2Si and aluminum is so slight that the melting of the eutectic proceeds very slowly and is really merged in the upper arrest when CuAl_2 melts.

In addition to these most interesting theoretical considerations, the authors have collected and plotted a large amount of information regarding influence of manipulation and chemical composition upon the hardening phenomena. This could best be induced in an alloy of normal composition (Cu, 3 to 4.5 per cent; Mg, 0.4 to 1.0 per cent; Mn, 0 to 0.7 per cent) by a quenching from 500 deg. C., followed by an accelerated aging for 5 days at about 100 deg. C., or 2 days at 150 deg. C. Careful physical measurements on a quenched sample showed a slight discontinuity in the linear expansion on heating at about 250 deg. C., and a change in direction in the curve of electrical resistance at about 325 deg. C.

In connection with the above discussion, a note by Zay Jeffries presented to the British Institute of Metals at its September, 1919, meeting is pertinent. Referring particularly to the fact that there is a certain average size of precipitated CuAl_2 particle which produces maximum strength and hardness, Dr. Jeffries points out that the "smallest globule resolvable under a high power microscope contains about 2 billion molecules, consequently the phenomenon of aging may very well involve changes which cannot be observed. He considers the process in two stages; immediately after quenching, the excess CuAl_2 is precipitated, some of it having agglomerated into small particles, but more as single molecules having little or no adhesion with the particles of the matrix. Therefore the adhesion and consequently the strength and hardness of the metal are low. Moderate heat allows molecular migration; the dispersed molecules are attracted to the larger particles adjacent, impoverishing the matrix at the boundary. "This accom-

plishes two things, namely, it facilitates migration of CuAl₃ toward the globule by the forces of diffusion, and it reduces the number of CuAl₃ molecules in the matrix at the boundary with the globule to normal saturation, which is the condition for maximum adhesion between CuAl₃ and the matrix." The cohesion of the matrix itself is increased by an increase in the normal forces in the space formerly occupied by the loosely held CuAl₃ molecule. Thus the mechanical strength and hardness approach a maximum. "If the particles of CuAl₃ continue to increase in size beyond a certain average and decrease in number, as in prolonged aging, at 200 deg., the cohesion decreases."

HEAT TREATING DURALUMIN CASTINGS

Duralumin in sheet or extruded products has for some time been commercially heat treated, a quenching from about 500 deg. C. showing an increase in hardness, especially after an aging of 4 days or more. Castings of the same composition [Cu up to 6 per cent, Mg up to 2 per cent, Mn up to 1 per cent, Si and Fe (as impurities in the commercial aluminum) up to 0.5 per cent each] have been investigated by Dr. Zay Jeffries and W. A. Gibson of the Aluminum Castings Co., who report in their paper on "Heat Treatment of Aluminum-Alloy Castings" that it is necessary to guard against oxidation of the somewhat porous castings from furnace atmosphere and quenching medium. When this is done, as for instance by heating in a bath of fused alkaline nitrates and quenching in oil, the strength and elongation are markedly increased and made much more uniform. Metallographically, this effect is shown to be due to the absorption of a network containing the compound CuAl₃. High-iron alloys also show needles of FeAl₃ within the grains, but these remain unabsorbed to a large extent. Physical tests were made of a large number of melts in a study of chemical composition. In general, the addition of iron (up to 1½ per cent) is more beneficial to low-copper alloys (3 per cent Cu) than high (6 per cent Cu); in the latter case the beneficial results of heat treatment are especially marked. A low-copper alloy with 1.4 per cent iron shows an increase in tensile strength, but a decreased elongation up to 1 per cent Mg.

MECHANICAL PROPERTIES

Since the alloy duralumin is used to a great extent in airplane parts and in other machine parts requiring a combination of lightness and high strength, it was thought desirable to investigate the mechanical possibilities of the light alloys of two somewhat analogous ternary series. Messrs. Merica, Waltenberg and Finn of the Bureau of Standards did the work in co-operation with the Aluminum Company of America, and their results were presented in a paper entitled "Mechanical Properties and Resistance to Corrosion of Rolled Light Alloys."

Light aluminum alloys of several compositions belonging to each of the three ternary series aluminum-magnesium-copper, aluminum-magnesium-manganese, and aluminum-magnesium-nickel were rolled out into sheets and tested in tension as cold-rolled, after annealing, and after heat treatment, consisting of quenching from about 500 deg. C. and aging at ordinary temperature.

The tensile properties of the alloys of the aluminum-magnesium-copper series were superior in all conditions to those of the other series. They may be much improved by an appropriate heat treatment. The alloys

of the aluminum-magnesium-nickel series are also improved by heat treatment, but not in the same degree as the former series. The alloys of the aluminum-magnesium-manganese series are not improved by heat treatment.

Samples of representative compositions of each series were exposed to corrosion in the salt spray test, and the appearance of the samples was observed after exposure to the action of the salt spray for one and for two months. The alloys of the aluminum-magnesium-manganese series resisted corrosion, in general, better than those of the other series, and this observation agrees with other experiences in the corrosion of such alloys. The heat-treated specimens of the aluminum-magnesium-copper series, however, were but little inferior to those of the manganese series in their resistance to corrosion; the annealed and the cold-rolled samples of that series were the least resistant to corrosion of any of the alloys tested. Hard-rolled commercial aluminum corroded much more than any of the alloys. Annealed aluminum was more resistant to corrosion than the hard-rolled aluminum, but did not compare favorably with most of the alloys.

MANGANIN AND CONSTANTAN

Manganin, by virtue of its use in electrical instruments, must have a very small temperature coefficient of resistance and thermal e.m.f. against copper at room temperatures. Studies, described by F. E. Bash, research engineer of Leeds & Northrup Co., made to discover methods of commercial manufacture of this wire, formerly available from Germany only, developed the fact that exactly reproducible results could be had by melting 83 parts of electrolytic copper and 2.5 parts of electrolytic nickel in a magnesia-lined graphite crucible. After liquefaction, the melt is covered with charcoal, and 14 parts of thermit-manganese stirred in by a cool iron rod in two batches. There was then added 1.5 parts pure iron wire to the superheated melt, the alloy deoxidized by 0.1 per cent of magnesium, wired to the stirring rod, and immediately poured into iron molds. This melting practice is very important and guards against the introduction of silicon, which causes great variation in electric properties, and keeps the oxygen at a minimum. Annealing during working must be done in reducing atmosphere, or else the low-manganese skin removed by pickling before the final draw. If nickel is replaced by aluminum, somewhat better mechanical properties result, and the thermal e.m.f. is reduced to 0.3 microvolt. In any case a surface action, probably an oxidation, causes a slow change in the electrical properties with time, especially if the wire is oil-immersed.

An especially interesting paper by the same author on "Manufacture and Electrical Properties of Constantan" described the company's work in making that nickel-copper alloy to replenish its exhausted stock of imports. For its particular use it was necessary that new thermocouple wire should develop the same thermal e.m.f. against iron as the old stock, in order that calibrated dials on indicating and recording instruments would read correctly. In other words, at 1500 deg. F. the e.m.f. should equal the company's standard, or 47.40 millivolts within ± 1 per cent.

Preliminary laboratory melts synthesizing known analyses were first tried, and it was soon noted that practically the same e.m.f. was given by alloys of quite different analyses. Consequently an extended

investigation of the effect of physical treatment on the wire was undertaken, but with negative results, since it was demonstrated that no appreciable segregation occurred in the ingot, and the electrical characteristics were the same after working and annealing at various temperatures and in various atmospheres. Therefore the research veered back to the chemical analysis.

A study of melts made with electrolytic nickel and copper showed that their e.m.f.'s against ingot iron at 1500 deg. F. when plotted against composition gave a flat peak between 70 and 40 per cent copper. As a basis of further work, a 55:45 copper-nickel alloy giving 53.25 millivolts was selected as a standard ratio for the main ingredients. Keeping this constant and adding successive amounts of pure manganese, it was found that the e.m.f. dropped in direct ratio to the amount of addition, 3 per cent manganese lowering the value 9.5 millivolts. Likewise iron, silicon and carbon were tried, all giving linear reductions; 0.7 per cent iron lowering the value 7.7 millivolts; 0.7 per cent silicon 5.75 millivolts, and 0.7 per cent carbon 4.65 millivolts.

With this information it was possible to compute likely analyses which would give the desired e.m.f.; laboratory melts of this sort were tried. Sometimes the electrical properties were correct, but quite often were too high or low, due to scavenging and losses in manganese or silicon, or unavoidable addition of iron or carbon in the furnace work.

These small scale melts were made in a granular resistor furnace. In the center of the resistor was placed a No. 1 graphite crucible with the bottom sawed off. In the bottom was a thin layer of granulated carborundum. Crucibles gave much trouble. The ordinary graphite crucible put too much silicon into the melt, while a fire-clay crucible did not stand up well. Sand crucibles could not resist the furnace conditions. Alundum was excellent as far as keeping the melt pure, but it was ordinarily good for only one melt, and not that if by chance it came in contact with the graphite walls at high temperatures. Quartz was wholly satisfactory and stood several melts. Electrolytic cathode cuttings were melted in a reducing atmosphere, and the thin film of oxide slag reduced by a pinch of carbon. Proper additions were then made, stirred in with a silica tube, and when liquefied the melt chill-cast in a $\frac{1}{4}$ -in. square ingot. This was rolled down to 0.1-in. square, annealed and tested electrically.

After this preliminary work, a regular 4-ton heat was made by the International Nickel Co., in an oil-fired open hearth. A number of different additions were made to 275-lb. ladles of metal, poured at about 2700 deg. F. into 57-lb. sand-cast test bars and a 200-lb. ingot. The analyses were remarkably constant, showing that by careful furnace work it was possible to hold the iron to within 0.05 per cent and the manganese to 0.10 per cent. E.m.f.-composition curves similar to those obtained in the laboratory resulted. Wires drawn from the ingots were made into 60-lb. coils, and each tested for e.m.f., varying from +1.6 millivolts to -1.3 millivolts from the standard, although 101 out of 149 coils were within the tolerance ± 0.5 millivolts. From later melts aggregating 40,000 lb. only 25 per cent was accepted, due to small variations in impurities such as crept into the laboratory melts. The only way such wire can be made is to predict as close an analysis as possible and then test each coil separately for thermal e.m.f., rejecting any which falls without the desired limits.

PAPERS ON GUN METAL

C. P. Karr of the Bureau of Standards reported on a test among five foundries on the strength of Government bronze (88 Cu, 10 Sn, 2 Zn). One of the foundries prepared ingots from virgin metal, which were then divided among the co-operating concerns. A first series of test-bars, cast even under rather definite instructions, gave rather wide variations; merely an example of the extreme care necessary to get comparative tests on this alloy so sensitive to moderate changes in gating, molding, or temperature. After discussion of results, a new set of bars were cast in a standard mold similar to Fig. 8, poured flat with reservoir gates made in green sand. The core-sand mold itself had linseed oil as binder and was baked in a core-oven. Even with this practice, considerable variation in physical properties from the same foundry were found, and even greater variation in bars from different

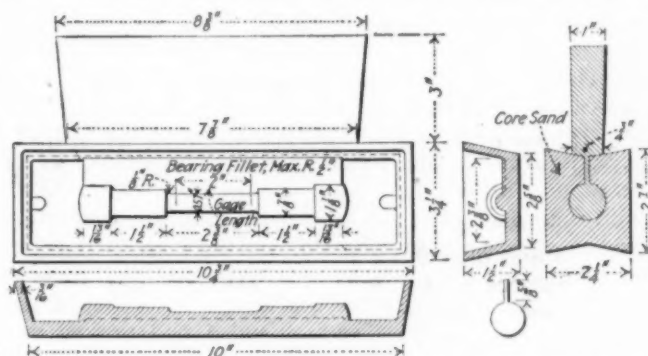


FIG. 8. CORE BOX USED IN MAKING SHOULDERED TEST-BARS

plants. In general, coarse sand allowing ready gas escape will give high strength, while thin castings poured hot will have low elongation. Results follow:

Composition	Number of Specimens	Proportional Limit	Tensile Strength, Lb. per Sq. In.	Elongation in 2 In., Per Cent.	Reduction in Area, Per Cent.
88 Cu, 10 Sn, 2 Zn	30	12,200 $\pm 1,600$	38,900 $\pm 5,250$	25.3 ± 5.9	21.0 ± 4.7
88 Cu, 8 Sn, 4 Zn	26	11,000 $\pm 1,650$	39,400 $\pm 4,200$	32.0 ± 7.0	25.0 ± 4.6

A research was undertaken by Prof. C. F. Swart of the University of Michigan to discover whether quenching 88:10:2 bronze will increase or decrease its strength and ductility, a point variously reported by previous investigators. In a paper entitled "Influence of Heat Treatment on Gun Metal," he notes that furnace-, air-, or water-cooling after a 30-min. anneal at 600 deg. or less will equal or better the properties of sand-cast test bars, but the specimens quenched in water from higher temperature anneals showed lower tests and the fracture had a coarsely crystalline band some 2.5 mm. thick around a fine-grained center. Microscopic examination of etched samples in the sheath showed irregular crack-like markings thought to be strain lines, and in specimens which were turned down to remove this strained surface almost normal values for strength and ductility were restored.

Considerable difference in opinion as to this question developed in the meeting. Dr. Karr of the Bureau of Standards said that their high results on quenched bars were not due to machining off the skin, as suggested by the author, as all shaping was done prior to heat treatment. R. F. Wood said his experience indicated that the strength of this bronze could be reduced from 40,000 to 18,000 lb. per sq.in. by quenching after annealing at 700 to 800 deg., even though the piece be air-cooled

to no color before immersion. P. E. McKinney observed that practice at the Naval gun factory demonstrated that a sound red-bronze casting could be strengthened by annealing. Large castings must then be quenched to prevent large crystalline growth of the alpha constituent, when annealing must follow to relieve cooling strains. He was of the opinion that cracking in such metal was due to careless handling of the piece at a very tender stage rather than to quenching stresses.

In order to conserve the war-time supply of tin, it was suggested that an alloy containing 90 per cent Cu, 6.5 per cent Sn, 1.5 per cent Pb, and 2 per cent Zn be used in place of the 88:10:2 gun metal, since the former alloy was said to have better qualities in almost all respects. H. F. Staley and C. P. Karr investigated this and a number of analogous compositions at the Bureau of Standards, and have reported their findings in a paper entitled "Physical Properties of Certain Lead-Zinc Bronzes." Of the nine alloys investigated it was actually found that only two or three are somewhat superior to gun metal in ductility, and are about equal to it in other respects. Substitution of lead above $\frac{1}{2}$ per cent for zinc or tin, or substitution of zinc above 2 per cent for tin, was found to lower the quality of the castings. Since the compositions fall within the α solid solution field of the copper-tin diagram (regarding zinc as equal to $\frac{1}{2}$ part of tin, and lead as an insoluble impurity), heat treatment has little effect upon the properties of the bars. In the discussion it developed that the substitute analysis recommended had proved very successful for small hydraulic valves. It was also urged that a series of tests on nickel-bearing bronzes be immediately undertaken, in view of the large quantity of copper-nickel shell-rotating bands now available at a low price.

Phosphorus and Sulphur Limits in Steel

Representatives of the American Society of Testing Materials held a meeting with members of the metallurgical section of the Bureau of Standards, representatives of the U. S. Railroad Administration, steel manufacturers, the Shipping Board, automobile industry and other steel consumers in Philadelphia, Oct. 14, and agreed upon an investigative program covering the question of phosphorus and sulphur limits in various grades of steel.

A tentative program of laboratory investigations and service tests has been mapped out, involving the co-operation of steel manufacturers, users and the Bureau of Standards. The economic importance of this question is recognized by all of the co-operating institutions, due to changing conditions relating to several factors of steel manufacture, such as the gradual increase of phosphorus in available iron ores, the large amount of high sulphur scrap and the poor quality of fuel with its high sulphur content.

According to the tentative program, the test for sulphur will be made first on rivets, steel tubes, etc., and secondly on plates and structural shapes, including boiler plates.

Commercial Fair to Be Held at Brussels

The first annual commercial fair of the city of Brussels will be held April 4 to April 21, 1920. Only allied and neutral countries will be allowed to participate.

Chicago Section Meeting, American Chemical Society

THE regular meeting of the Chicago Section of the American Chemical Society was held in the Monadnock building, Chicago, at 8 P. M. Friday, Oct. 24, with the usual large number of members in attendance. The report of the executive meeting was read, the principal feature of which was the proposal of Dr. William A. Noyes for president of the American Chemical Society at the next election. The report of the finance committee revealed extensive preparations for a real welcome to the visiting members of the Society at the annual meeting next year. Dr. L. V. Redman, chairman of the Chicago Section, cited the performance of the Philadelphia Section, in September, as an example of what may be done along those lines of warm hospitality. The report of the membership committee showed the acquisition of many women members. Furthermore, many of these members are in regular attendance at each meeting.

The paper of the evening was presented by Dr. C. A. Tibbals, associate professor of inorganic chemistry, Armour Institute, and late Captain, Ordnance Department, U. S. Army. An abstract from Dr. Tibbals' paper follows:

EXPLOSIVES RESEARCH AND TESTING

The Picatinny Arsenal is an old Government establishment, having been started in the early '80s for work on the production of propellants and high explosives. At the beginning of the war there was in operation there a black powder factory, producing a standard powder for the Government and incidentally the best black powder used during the war; and an ammonium picrate plant, making the Government Explosive D, the only practical high explosive of which we had knowledge at that time. This plant was supplying the peace-time requirements for high explosives. These two plants had control, inspection division and very small research laboratories.

The laboratories were taken as the nucleus for the organization of an adequate research unit. The problems which confronted the organization were (1) large quantity production, (2) shortening of time from explosive plant to field, and (3) the development of a flashless propellant. This last item was needed to prevent revelation of battery positions to the enemy during night firing. Smokeless powders produce a bright flash. The new requirement was met by the incorporation of certain powders in the smokeless charge which reduced the temperature of the gases of explosion by the time they reached the muzzle of the gun. They were in successful use in the field at the close of the fighting and were known as P. A. No. 1 and P. A. No. 2.

The arsenal made high explosives, loaded and used them in shells of all sizes, hand and rifle grenades, trench mortar shells and aerial drop bombs. High explosives were tested for (1) stability, (2) sensitiveness, (3) hygroscopicity, and (4) surveillance.

After the laboratory routine was completed the power of explosion was noted by several methods, among which was the sand test.

Very few of the many proposed explosives were recommended.

Symposium on Industrial Alcohols

First Fall Meeting of New York Section of American Chemical Society—Future of Industrial Alcohols—Ethyl Alcohol From Wood Waste—Alcohol From Sulphite Waste Liquor—Alcohol in the Dye Industry—Higher Alcohols

THE first regular meeting of the New York Section of the American Chemical Society for the 1919-20 season was held on Friday, Oct. 10. The evening was devoted to a symposium on alcohols, attention being focused upon the production and industrial uses of the more important alcohols.

The Future of Industrial Alcohols

MR. B. R. TUNISON discussed the factors which will influence the development of the industrial alcohol industry. New and important applications have been worked out, so that the outlook for the future is most promising.

Ethyl alcohol, the most important of the industrial alcohols, has been subject to so much taxation in the past that substitutes have been used in many cases where pure ethyl alcohol would have been more suitable. Thus manufacturers have been forced to use methyl alcohol for purposes to which ethyl alcohol was better adapted.

The production of other alcohols is a new industry in the United States. The war cut off the foreign supply of these alcohols, and their production, separation and purification constitute one of the rapidly growing industries of this country.

RAW MATERIALS

From the chemical and engineering viewpoints, almost any saccharine or starchy material may be used as a source of alcohol. Commercially, however, economic conditions operate to limit the available raw materials. Thus in Germany during the pre-war period agricultural conditions were such that potatoes were cheaper than grains. Beet-sugar molasses was used as a feeding material and as fertilizer, and there was not sufficient fruit waste to compete with potatoes. In France, grain, sugar beets and beet molasses are utilized. Switzerland's cheap water power has encouraged the development of a process starting with acetylene.

For many years maize was the chief source of alcohol in the United States. Waste sulphite liquor has been suggested, but there are very few mills which can supply sufficient waste liquor to keep a large plant in continuous operation. Grains are available only when not required as foodstuffs. Potatoes cannot be grown cheaply enough, and fruit waste is not available in sufficient quantity. The chief source at the present time, and the one which will apparently continue to occupy a leading position, is cane or black strap molasses from the sugar refineries of Cuba, Porto Rico and southeastern United States.

Many suggestions have been offered concerning new raw materials for the manufacture of industrial alcohol. Among these may be mentioned artichokes, sorghum, fruits and fruit wastes, berries, the nipa palm of the Philippines, the sotol plant of Mexico, cassava, garbage waste, and ethylene recovered from gas and coal-tar distillation plants. It is evident that the main consider-

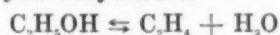
ation is an abundant, concentrated and constant source of raw material supply, since a plant producing only 100 gal. per day will require the equivalent of 200 gal. molasses or 2 tons of shelled corn every day. Molasses will undoubtedly be the chief source for a long time to come, since methods and apparatus are already well standardized for the use of this material and research work is being done upon the fermentation process with a view to improving yields.

USE IN TURPENTINE INDUSTRY

The turpentine gum is extracted with ethyl alcohol, which dissolves the gum turpentine but not the impurities. The solvent may be separated from the turpentine by fractional distillation. The rosin residue is of excellent quality and very light in color. The alcohol recovered contains turpentine which acts as a denaturant and may be sold as denatured alcohol or used for the extraction of a second batch of material.

ETHYLENE

When the vapors of alcohol are passed over heated kaolin or other suitable catalytic agents, ethylene is formed by catalytic dehydration



By means of this reaction, ethylene can be produced on a commercial scale at a price which enables it to compete with acetylene. Acetylene is not suitable for welding copper, as it produces blisters in the metal. Ethylene, however, may be successfully employed for this purpose. There is no danger of spontaneous explosion in compressing ethylene, so it may be compressed directly into cylinders without the use of the solvent acetone. Consequently a lighter container can be used, thus saving approximately one-half on the cost of the cylinder and on freight charges. Ethylene is a "one-man" gas, that is, a cylinder of a size sufficient for welding operations can be easily handled by one man. The gross weight, including the cylinder, per 100 cu.ft. of ethylene is only 40 lb., while the corresponding figure for acetylene is 90 lb. Ethylene is being sold in cylinders under the trade name of "calorine" at the same price as acetylene.

FUEL

The use of solidified alcohol as an easily transported, convenient source of heat is constantly increasing. It is unexcelled for use in localities where gas and electricity are not available.

The removal of many of the restrictions on the production, distribution and use of industrial alcohol will enable it to serve as a commercial fuel for internal combustion engines. It is claimed that the peak in the production of petroleum will be reached within the next two or three years. Even at the present time the demand for motor fuel exceeds the supply, so that there is urgent need for new sources of fuel. At the present time carburetors are not adapted to use alcohol alone,

but various mixtures have been tried giving better results than the present day gasoline. The most successful of these are mixtures of alcohol, gasoline, benzol and blending agents.

EFFECT OF INDUSTRIAL ALCOHOL ACT

It is hoped that the industrial alcohol act will relieve the manufacturer of industrial alcohol of much of the inconvenience hitherto experienced. The forms called for even at the present time are easy to execute and it should be possible to build up a large industry. The need for such an industry under present conditions is readily understood when we consider the question of where, without whiskey distilleries, shall we look for alcohol in case of war. The only answer possible is—the industrial alcohol industry.

The accompanying chart presents in graphic form some of the many uses of alcohol, and shows clearly the wide range of industries which require alcohol either as raw material or as a solvent.

Ethyl Alcohol From Wood Waste

DR. F. W. KRESSMANN discussed some of the conditions affecting the yield of alcohol produced by the hydration of cellulose in wood waste. The process has been systematically investigated by the Forest Products Laboratories. The optimum pressure was found to be $7\frac{1}{2}$ atm. and the critical temperature 165 deg. C. Cooking time was found to be without influence on the total sugar, but the percentage of fermentable sugar increased with the time of cooking. The earlier work on this process was done with an amount of water equal to 400 per cent of the weight of the wood. It was found that 100 per cent of water gave the same or even a slightly better yield. The effect of varying the quantity of sulphuric acid used was determined in a series of tests using 125 per cent water, $7\frac{1}{2}$ atm. pressure, and an instantaneous cook. The yield of alcohol increased rapidly up to 1.8 per cent H_2SO_4 .

Alcohol From Sulphite Waste Liquor

DR. RALPH H. MCKEE reviewed the recent progress in the utilization of sulphite liquor as a source of alcohol. The usual procedure is to heat sulphite liquor with lime sludge, filter off the precipitate of calcium sulphate and calcium sulphite and ferment the neutral liquor. The alcohol obtained contains up to 3 per cent of methyl alcohol and can be purified only with great difficulty. In 1918 this process, known as the "Ekstrom process," was in use at 15 plants in Norway and Sweden, 12 in Germany and Austria and at 1 plant in the United States. The total production for that year was about 6,000,000 gal. The explanation commonly given to account for the low yield is that a local excess of lime acts upon the sugar in the neutralization step, it being well known that glucose is readily destroyed by alkalis.

About two years ago, certain experimental work carried out in the Chemical Engineering Laboratories at Columbia University seemed to indicate that the inhibiting effect of sulphur dioxide and sulphites on the fermentation was due to the fact that they are reducing agents and thus use up the dissolved oxygen of the liquor. Bubbling air through the liquor tends to counteract this and waste liquor from which a portion of the free SO_2 has been removed ferments readily in the presence of yeast and a current of air.

The process is in operation at the plant of the Hamermill Paper Co., Erie, Pa. Fermentations have lately

been made on 10,000 gal. charges and a small commercial size still capable of turning out 200 gal. 95 per cent alcohol per day has just been installed. The method of operation is as follows: The hot waste liquor (1400 to 2000 gal. per ton of pulp) is boiled in a preliminary treatment tank for about five hours, a current of air being introduced simultaneously. The SO_2 set free may be recovered, although this is not being done at this plant. The hot liquor is cooled counter-currently with water to about 29 deg. C., when it is run into the fermentation tank. Yeast and yeast foods such as ammonium sulphate and calcium acid phosphate are added. During fermentation a slow current of air is blown through the tank, furnishing oxygen for the yeast and keeping the yeast in suspension. After fermentation the alcohol is distilled in a continuous still to give high wines (50 per cent alcohol), which are rectified in discontinuous or batch stills.

The cost of production at this plant is from 18 to 30c. per wine gallon of 95 per cent alcohol, according to the glucose content of the waste liquor used. This cost includes charges for depreciation, interest, labor, steam, etc., but no charge for the sulphite liquor.

With a yield of 1 per cent of the waste liquor, there is obtained on an average 18 gal. of 95 per cent alcohol per ton of pulp. There are 95 mills in the United States producing an aggregate of 1,500,000 tons of sulphite pulp a year, so that the possible production is large.

Use of Alcohol in the Dye Industry

In speaking of the importance of alcohols in the dye industry, DR. LEONARD H. CRETCHER said that methyl and ethyl alcohols were extensively used as intermediates and as solvents.

The alcohols are spoken of as intermediates when used for alkylation. Dimethylaniline, prepared from methyl alcohol and aniline, is the most important alkylated amine. From dianisidine, representative of the class of alkylated phenols, benzopurpurine is prepared. Dyes themselves may also be alkylated. Ethyl esters of acetic and oxalic acids form another important class of products.

Higher Alcohols

DR. G. F. RICHMOND classified the higher alcohols used in the perfume industry briefly as follows:

1. *Methane Group.* Methyl alcohol is used as methyl salicylate and anthranilate. High-grade ethyl alcohol is essential to the manufacture of perfumes. Iso-butyl alcohol is indispensable for the preparation of musk odors. Amyl salicylate is the basis of perfumes of the orchid type. Octyl alcohols give that sweet smell "which distinguishes a rose from a rose perfume." The alcohols with twelve carbon atoms have a delicate odor suggestive of the lily.

2. *Geraniol Group.* Geraniol is found in otto of rose. Other members of this group are nerol, linalool, itronellol and rhodinol.

3. *Terpene Group.* Terpeneol is the most important member of this group. It is used in lily of the valley and lilac perfumes and in soap scents.

4. *Aromatic Alcohol Group.* Benzyl alcohol, phenyl ethyl alcohol and cinnamyl alcohol are representative of this group.

The complexity of the problem is further increased by the fact that, of the 36 distinct alcohols used, many may also be used as aldehydes and ketones or combined with any one of 25 acids as esters.

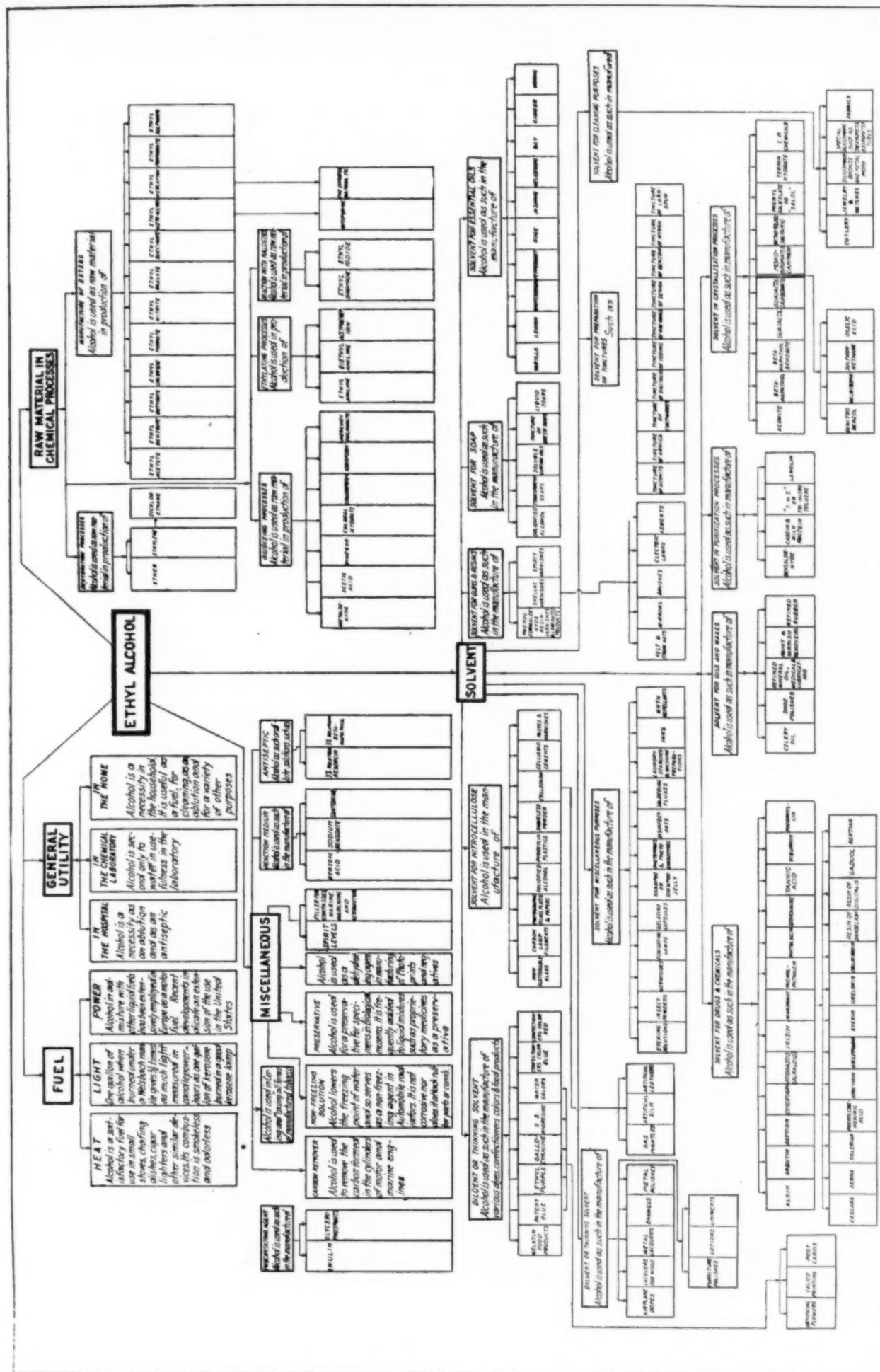


CHART SHOWING SOME OF THE MANY USES OF ALCOHOL

Application of the Interferometer to Gas Analysis

Principle of the Interferometric Method as Applied to Gas Mixture Analysis—Effect of Variations in Gas Composition and Experimental Conditions—Typical Examples of Interferometric Determinations on Carbon Dioxide-Air, Flue Gases, Helium-Nitrogen-Methane Mixtures

BY JUNIUS DAVID EDWARDS

IT IS only within recent years that extended practical application of physical methods to chemical analysis has been made. This has been especially true in the case of gas analysis. Progress in developing new and improved methods for gas analysis was slow so long as differentiation by chemical characteristics alone was employed. However, there are quite a number of physical characteristics of gases, such as refractivity, thermal conductivity, heat of combustion, density, viscosity, etc., which offer almost unlimited possibilities for the development of gas analysis apparatus for various purposes.

One of the most useful of the physical methods which have been developed is that of gas interferometry. Rayleigh¹ first described the essential features of this method. Later Haber and Lowe² developed what is known as the Rayleigh-Zeiss gas interferometer, which marks the first practical application of the method. Interferometers of the Rayleigh type are now manufactured by Hilger of London. Although widely used abroad, the number in use in this country has been rather limited—less than their utility would warrant.

The author³ has described a new method of calibrating the gas interferometer, which greatly simplifies and extends its use. The present paper will discuss the simple relations which exist between the properties of the gases and the indications of the instrument, and give examples illustrative of its use.

PRINCIPLE OF METHOD

The gas interferometer is essentially a differential refractometer; it measures the difference in refractivity of two samples of gas. The gases are contained in two long (100 cm. in one instrument) narrow gas chambers, the ends of which are closed by plane parallel glass plates. White light from an illuminated slit passes through both chambers, after which the two beams combine to produce interference fringes which are observed through an eye piece. If the composition of the gas in the two tubes is different, the optical paths through the tubes are different and the interference fringes are displaced from their normal position. The optical path of one of the beams can be adjusted to equality with the other by tilting a glass compensator plate, which is placed in the path of the beam. The angle through which the compensator plate must be turned to bring the two optical paths to equality, as shown by the position of the interference fringes, is a measure of the difference between the refractive indices of the two gases. This adjustment is made by means of a micrometer screw acting on a lever arm attached to the compensator plate. A second set of fringes, produced by two beams of light which pass over the

gas tubes and which are fixed in position because the two beams always have equal optical paths, are used as a reference point in much the same way as the cross hair in a telescope. The reader is referred to the more complete descriptions in the literature for further details of the apparatus.

THEORETICAL RELATIONS

The refractivity (R) of a gas is equal to the refractive index minus 1.

$$R = n - 1 \quad (1)$$

It has been shown that the refractivity of a gas is proportional to its density, or

$$\frac{R}{d} = \text{constant} \quad (2)$$

This relation holds with considerable exactness for gases at ordinary temperatures and within a pressure range of a few atmospheres. From equation 2 the refractivity of a gas can be calculated for different temperatures and pressures by the application of the gas laws, since the density of a gas is proportional to its pressure. When the deviations of the gas from the simple gas laws are important, they can be taken into account, as will be shown later.

The refractivity of a gas mixture can be calculated from the refractivity of the components and the composition of the mixture. In a binary mixture, composed of gases having refractivities R_1 and R_2 , the refractivity, R , for any proportion of the two gases is given by equation 3, in which a and $(100 - a)$ are the proportions in which they are present.

$$R = \frac{R_1 a + R_2 (100 - a)}{100} \quad (3)$$

The available evidence shows that this equation holds with considerable accuracy. For example, the refractivity of air, calculated in this manner from the values given in Table I for the refractivities of its constituents, is 2915×10^{-7} as compared with the observed value 2917×10^{-7} .

The reading of the interferometer is a measure of the difference in refractivity of the gases in the two chambers. This difference in refractivity can be easily calculated from the preceding relations. If R_1 is the refractivity of one gas at 0 deg. C. and 760 mm., and R_2 is the refractivity of the second gas or standard of comparison under the same conditions, then the difference of refractivity of the two gases at any pressure p and absolute temperature T is as follows:

$$(R_1 - R_2)_{T,p} = \frac{273}{T} \cdot \frac{p}{760} \cdot (R_1 - R_2) \quad (4)$$

The interferometer reading is determinate only for binary mixtures or their equivalent; mixtures of constant composition, such as air, for example, may be regarded as a single component. It is the usual practice where convenient to use one of the components of the

¹Rayleigh, *Proc. Roy. Soc.*, 59, p. 201, 1896.

²Haber and Lowe, *Zangew. Chem.*, 23, p. 1393; 1910.

³Edwards, *J. Am. Chem. Soc.*, 39, p. 2382; 1917.

gas mixture as the standard gas. In this case the difference in the refractivity of the mixture and one of its components is measured. If R_1 and R_2 are the refractivities of the two gases, then the change in the refractivity of the mixture (ΔR) for a change of a per cent of one of its components is as follows:

$$\Delta R = \frac{273}{T} \cdot \frac{p}{760} \cdot \frac{a}{100} (R_1 - R_2) \quad (5)$$

Equation 5 also represents the change in the difference between the refractivity of the mixture and any standard gas for the change in composition stated. The symbol ΔR will be used to represent the change in refractivity of the mixture for a given change in composition, and the symbol Δr will be used to represent the difference in refractivity between the gases in the two chambers. Under certain conditions ΔR and Δr are numerically equal, but a distinction is made to simplify the discussion of certain problems.

CALIBRATION OF INTERFEROMETER

Each scale division of the interferometer corresponds to a definite value of Δr which is a characteristic of the instrument. If now the interferometer could be calibrated in terms of Δr so that the refractivity difference for any scale reading was known, then its calibration for any gas could be calculated if the refractive index of that gas is known.

The author has described a method of calibration of the interferometer, based on this principle,⁴ which is extremely simple and easy to carry out. To determine the scale reading corresponding to a given difference in refractivity, both chambers of the interferometer are filled with dry air, free from carbon dioxide, and at a definite temperature and pressure. The pressure and hence the refractivity of the gas in one chamber is then varied progressively and the scale reading corresponding to each pressure noted. The pressures in the two chambers are p_1 and p_2 , and the temperature T remains constant. The refractive index (n_D) of air, free from carbon dioxide, at 0 deg. and 760 mm. pressure as determined by Meggers and Peters⁵ is 1.0002917.

It follows from equations 1 and 2 that ΔR , or the difference in refractivity corresponding to each scale reading (observed reading minus "zero" reading), can be calculated as follows:

$$\Delta R = \frac{273 \times 0.0002917 (p_1 - p_2)}{760 T} \quad (6)$$

From the curve of refractivity differences determined in the above manner, the scale reading corresponding to the refractivity difference calculated from equation 5 can be ascertained and a curve constructed giving the scale reading for any percentage of the gas for which the calibration is desired.

REFRACTIVITIES OF THE GASES

It is apparent that the accuracy of this method of calibration is limited among other things by the accuracy with which the refractive indices have been determined. The refractive index of air is known from the work of Meggers and Peters to within a part in a thousand. The refractive indices of most of the other common gases are known with sufficient accuracy to be used for calibrating the interferometer. The tables of refractive indices, such as that given by Landolt-Börnstein, are somewhat confusing because of the

differences between the observations of different experimenters. Therefore, in arriving at the most probable value for any of these constants it is necessary to make a critical examination of the details of the measurements, whenever possible. In Table I are given the refractive indices of a number of the common gases. The values are all for a wave length of 589×10^{-6} mm. (sodium or D line), since the data are most complete for this wave length and it represents fairly well the average wave length of the light used in the interferometer. The values given in this table have been found by taking the average of the most reliable observations and represent the author's judgment of the best values to use.

It will be noted that the refractivity values in this table are for gas at 0 deg. C. and under a pressure of 760 mm. of mercury.

TABLE I—REFRACTIVITY OF CERTAIN GASES

Gas	Formula	Refractivity $\times 10^{-7}$	"Ideal" * Refractivity $\times 10^{-7}$
		0 Deg. C. and 760 mm.	0 Deg. C. and 760 mm.
Air.....	.....	2917†	2916
Oxygen.....	O ₂	2706	2704
Nitrogen.....	N ₂	2972	2971
Hydrogen.....	H ₂	1387	1388
Helium.....	He	0342	0342
Neon.....	Ne	0671	0671
Argon.....	Ar	2809	2807
Krypton.....	Kr	4270	4259
Xenon.....	Xe	7020	6968
Carbon monoxide.....	CO	3347	3346
Carbon dioxide.....	CO ₂	4498	4467
Methane.....	CH ₄	4415	4408
Ethane.....	C ₂ H ₆	7660	7578
Ethylene.....	C ₂ H ₄	7266	7209
Acetylene.....	C ₂ H ₂	6020	5971
Cyanogen.....	C ₂ N ₂	8490	8320
Sulphur dioxide.....	SO ₂	6760	6628
Ammonia.....	NH ₃	3821‡	3779
Nitrous oxide.....	N ₂ O	5160	5122
Nitric oxide.....	NO	2950	2947

* See next section.

† Meggers and Peters, *loc. cit.*

‡ Cragoe and Peters, unpublished value from Bureau of Standards.

REFRACTIVITY AT LOW PARTIAL PRESSURES

For small changes in pressures or temperature the density and therefore the refractivity can be calculated with sufficient accuracy by means of the gas laws as indicated in equations 4, 5 and following. If, as is usually the case, a small percentage of a gas is being measured, its partial pressure will be small. If the deviation of the gas from Boyle's law is significant, the refractivity of the gas at this low partial pressure may differ from the value calculated from the ratio of the pressures. The correction necessitated by this fact will now be discussed.

The refractivity of a gas is the sum of the refractivities of its constituents. If the molecules in a mixture of gases could be sorted out and the refractivities of each kind totaled, the refractivity of the mixture could probably be ascertained with high precision. Because this is not possible, we have used in the discussion a larger unit of measurement, which is the number of molecules contained in a unit volume of the gas at a definite temperature and pressure. It is therefore necessary to know how the number of molecules in a unit volume varies with changes in temperature and pressure. This variation is given with close approximation for many gases by the simple gas laws. In order to calculate the number of molecules of each kind in a mixture of gases, we have further made use of what is known as Dalton's law.

Dalton's law, as commonly expressed, states that the pressure of a mixture of gases is equal to the sum of

⁴Bull. Bureau of Standards 14, p. 473; 1917. *J. Am. Chem. Soc.*, 39, p. 2382; 1917.

⁵Bull. Bureau of Standards, 14, p. 697; 1918.

the pressures which each gas would exhibit if it occupied the total volume alone. In applying this law, we have assumed according to Boyle's and Avogadro's laws that the number of molecules in a unit volume is proportional to the pressure. If Dalton's law were strictly true, then the exact refractivity at any partial pressure could be calculated by using the observed expansion coefficients or, what is the same thing, correcting the values calculated by Boyle's law for the deviations from it. Dalton's law, just as Boyle's law, is, however, strictly correct only for the limiting case of perfect gases. Consequently, a gas at a pressure of 1 mm. does not necessarily have the same refractivity that it would if it had a partial pressure of 1 mm. in a mixture of gases. The reason for this is that in a mixture of gases the attractive forces between different species of molecules come into play and modify the volume relations. The more nearly two gases resemble each other in their physical properties (critical temperature and pressure, density, etc.) the less effect deviations of the gases from Boyle's law have upon their partial pressures. As an illustration, it is obvious that a partial pressure of 1 per cent of carbon dioxide in carbon dioxide, if we can speak of such a thing, shows no deviation from Boyle's law because it has already the same physical properties as the gas with which it is mixed, namely, carbon dioxide. However, a partial pressure of 1 per cent of carbon dioxide in air will show a certain deviation from Boyle's law.

The work of Berthelot,⁶ Fuchs⁷ and others have shown that the mixing of two gases originally at the same temperature and pressure is accompanied by a small increase in pressure or volume. The change in volume is a minimum when the gases which mix are most nearly alike in their physical properties. It appears, therefore, that in most cases the deviations from Boyle's law at low pressures should be taken account of in calculating the refractivities of mixtures, at least until more data are available on this point. In the case of mixtures of two gases, such as oxygen and nitrogen, or carbon dioxide and nitrous oxide, which are very similar in their physical properties, the use of the observed refractivities will give the best results. In the case of dissimilar gases, the "refractivities" at low partial pressures should be corrected for the deviations from Boyle's law.

The discussion of this point has perhaps taken more space than its importance would warrant, but because these facts are usually overlooked in similar cases, it has been thought desirable to call attention to them.

The deviation of a gas from Boyle's law can be calculated with sufficient precision from Berthelot's equation of state for gases and vapors. Jones and Partington⁸ have calculated by means of Berthelot's equation what they call the "ideal refractivity" of the gas. The "ideal refractivity" is, in effect, the refractivity at 0 deg. C. and 760 mm. calculated by means of Boyle's law from the refractivity at very low pressures. Consequently the refractivity of any gas at a low partial pressure can be more precisely calculated from this value by application of Boyle's law than from the observed value at 760 mm. The values for the "ideal refractivity" given in Table I should be used where the difference in refractivity caused by a small percentage of the gas is desired, subject to the conditions outlined

NOTES ON THE OPERATION OF THE INTERFEROMETER

In the use of the interferometer it will be noted that the readings are a function of the temperature and pressure. For the greatest convenience calibration curves should be drawn for different temperature and pressure intervals so that the correct reading can be obtained by interpolation. In the usual method of using the instrument and of calibrating with analyzed gas mixtures it is apparently customary to neglect the effect of temperature and pressure. It can be seen from the equations that if the readings are made at a temperature only 3 deg. C. higher or lower than the temperature at which the instrument was calibrated, they will be in error by 1 per cent. The errors from this source, if neglected, may easily be greater than any of the errors of calibration.

Another error in the use of interferometers which employ a glass compensator plate comes from the shift of the central white or achromatic fringe. This is due to differences in the relative dispersion of the gases and air and glass. L. H. Adams⁹ has analyzed this phenomenon for the Zeiss interferometer and developed equations by which the shift may be estimated. What takes place is that, as the concentration of a gas is changed, the edges of the central achromatic fringe gradually become colored and the original central fringe no longer is the most nearly achromatic fringe, provided the concentration change has been carried far enough. The result is in effect a shifting of the reference point.

The number of scale divisions through which the compensator must be turned to shift the achromatic fringe a distance of one band varies, of course, with every gas. The interval can be determined experimentally by increasing the concentration of the gas in one chamber gradually and constantly, meanwhile keeping the original central fringe in line with the reference fringe. (See section on principle of method.) The concentration can be increased gradually by allowing the gas to enter the chamber through a small needle valve and slowly dilute the mixture. If at any scale reading the original central fringe is still the most nearly achromatic, no error can result from that cause, because it would still be aligned with the reference fringe to obtain the scale reading. The scale reading when the achromatic fringe has shifted the width of one band should be noted.

A portable interferometer was tested in this way with carbon dioxide, which has a considerably higher dispersion than hydrogen, nitrogen, oxygen, etc. There was no uncertainty as to which was the original central fringe until concentrations as high as 60 to 80 per cent of carbon dioxide were reached. This is well beyond the range of instruments with 100 cm. gas tubes. Because of the low dispersion of most gases no difficulty will be usually met with from this source when low concentrations, say 20 per cent or less, are being used. Furthermore, when there is any doubt as to whether or not a shift has occurred, it can be determined experimentally in the manner indicated.

ILLUSTRATIVE CASES

To illustrate the use of the equations and show how the sensitivity of the interferometer varies under different conditions of use and with different gases, a number of typical cases will be discussed. The ease and simplicity with which variations in ΔR and its

⁶Berthelot, *J. physique*, 8, 3, p. 521; 1899.

⁷Fuchs, *Z. physik. Chem.*, 92, p. 641; 1918, from abstract, *J. Chem. Soc.*

⁸Jones and Partington, *Phil. Mag.*, 29, p. 28; 1915.

⁹Adams, *J. Am. Chem. Soc.*, 37, p. 1181; 1915.

equivalent, the scale reading, can be calculated for different conditions will be demonstrated. Although the instrument can in most cases be calibrated with analyzed mixtures, the method here described is usually as accurate, if not more so.

One of the commonest uses of the interferometer is for the determination of carbon dioxide in mixtures of carbon dioxide and air. There are three typical cases which may be considered. First, a mixture of carbon dioxide and normal air is compared with normal air as a standard. Second, a mixture of carbon dioxide and "air" in which there is a deficiency of oxygen is compared with normal air; such mixtures may occur in mines, for example. Third, a mixture of carbon dioxide and "air" in which there is a deficiency of oxygen is compared with the residue remaining after the carbon dioxide has been removed by absorption.

First Case. The difference in refractivity between normal air and air containing the same proportion of nitrogen and oxygen, together with 1 per cent of carbon dioxide, at 20 deg. C. and 760 mm. pressure can be calculated from equation 5.

$$\Delta r = \Delta R = \frac{273}{293} \cdot \frac{1}{100} (4467 - 2917) = 14.44$$

Second Case. If 1 per cent of oxygen in the above mixture is replaced by 1 per cent of nitrogen, then R_2 , the refractivity of the "air," is increased by 1 per cent of the difference between the refractivities of nitrogen and oxygen, and ΔR is apparently increased by the same amount, or

$$\frac{1}{100} \cdot \frac{273}{293} (2972 - 2706) = 2.48$$

The refractivity of the standard gas (air) remains constant. Accordingly the carbon dioxide, as indicated

by the calibration in the first case, will be $\frac{2.48}{14.44}$ of the 1 per cent, or 0.172 per cent too high for each change of 1 per cent of oxygen. For example, if the interferometer indicated 3.34 per cent carbon dioxide and the mixture contained 18.25 per cent oxygen, there would be a deficiency of 2 per cent $[(100 - 3.34) \times 0.2094 - 18.25]$ in the air, and the corrected percentage of carbon dioxide would be $3.34 - (2 \times 0.172) = 3$ per cent. This calculation neglects the fact that the value for the percentage of air in the gas $(100 - 3.34)$ is only a first approximation; a closer approximation to the correct value is obtained by using the corrected figures for carbon dioxide, which give $100 - 3.0 = 97$ per cent air. Using this value, the deficiency in oxygen is found to be 2.06 per cent instead of 2 per cent and the corrected percentage of carbon dioxide equals 2.99 per cent.

Burrell and Seibert¹⁰ determined the effect of a deficiency in oxygen experimentally and made six observations (0.135, 0.103, 0.128, 0.155, 0.162, and 0.160) from which they concluded that each 1 per cent lowering of the oxygen content increased the apparent amount of carbon dioxide by 0.15 per cent. In calculating their values they subtracted the percentage of oxygen in the mixture from the percentage of oxygen in normal air (they use 20.93 per cent). It is obvious, however, that the percentage of oxygen in the mixture varies with the amount of carbon dioxide present and the final value they calculate is, therefore, not a constant as assumed. Take their first observation: The mixture contained 0.50 per cent carbon dioxide and 20.19 per

cent oxygen. The air present in the mixture is then 99.5 per cent, and if it were normal air the percentage of oxygen in the mixture would be $99.5 \times 0.2093 = 20.82$ and the deficiency of oxygen, expressed as a percentage of the original mixture is $20.82 - 20.19 = 0.63$ per cent. The difference between the carbon dioxide indicated by the interferometer and by chemical analysis was 0.10 per cent. The error in the observed percentage of carbon dioxide for each per cent deficiency of oxygen is then $\frac{0.10}{0.63} = 0.159$ per cent, instead

of 0.135 as calculated by their method. When calculated on this basis, the average of Burrell and Seibert's six experiments is 0.166 per cent, which is in fair agreement with the value 0.172 calculated in the preceding paragraph.

Burrell and Seibert¹⁰ also concluded from six observations (0.174, 0.179, 0.138, 0.150, 0.167, and 0.179) that this figure was, for methane, 0.16 per cent for each per cent lowering of oxygen when normal air was used as standard. Their values recalculated on the correct basis give an average of 0.182 per cent, which is in fair agreement with the theoretical value of 0.179.

Third Case. The analysis of the third case, where the carbon dioxide is removed from the mixture before passing it into the second chamber to serve as the standard gas, is of especial interest because this method greatly reduces the errors due to other variations in the composition of the mixture and extends the use of the interferometer to other than strictly binary mixtures.

The effect of any variation in composition upon the difference in refractivity of the gases in the two chambers can be easily calculated. In the case at hand let R_1 be the refractivity of the constituent for which the calibration is sought and R_2 be the refractivity of the standard gas which remains after removal of the first gas from the mixture. Also let R_3 be the refractivity of the gas such as oxygen, nitrogen, etc., which dilutes the original mixture and also the standard gas. Then let a be the percentage of R_1 and b the percentage of R_3 which is present.

The difference in refractivity between the two chambers when a per cent of the first gas is in one chamber is given by equation 6.

$$\Delta r = \frac{a}{100} (R_1 - R_2) \quad (6)$$

If now b per cent of the gas having the refractivity R_3 is present the difference in refractivity between the two chambers is as follows:

$$\Delta r_1 = \left[R_1 \cdot \frac{a}{100} + R_2 \cdot \frac{(100 - a - b)}{100} + R_3 \cdot \frac{b}{100} \right] - \left[R_2 \cdot \frac{(100 - a - b)}{100 - a} + R_3 \cdot \frac{b}{100 - a} \right] \quad (7)$$

In this equation the quantities in the two brackets are the refractivities of the gases in the two chambers. It should be noted that the change of b per cent of the third gas in the mixture corresponds to a change of $\frac{b}{100 - a}$ in the residue after a per cent of the first gas has been removed. Equation 7 simplifies to

$$\Delta r_1 = \frac{R_1 a}{100} - \frac{0}{100^2 - 100a} \left[R_2 (100 - a - b + R_3 b) \right] \quad (8)$$

Subtracting equation 8 from 6 to determine the differ-

¹⁰Bureau of Mines Bull. No. 42, p. 73; 1913.

¹¹Bureau of Mines Bull. No. 42, p. 73; 1913.

ence in Δr , with and without the third gas, we have

$$\Delta r - \Delta r_1 = \frac{ab}{100^2 - 100a} (R_3 - R_2) \quad (9)$$

Equation 9 can be written by inspection when the relations involved are understood; however, it is developed in the above manner in order to make each step clear.

The effect on the indicated percentage of carbon dioxide in air, when the composition of the air varies, can now be calculated. If a , the percentage of carbon dioxide, and b , the change in percentage of oxygen from normal (20.94 per cent), are both 1, then at 20 deg. C.

$$\Delta r - \Delta r_1 = \frac{273}{293} \cdot (2706 - 2972) \cdot \frac{1}{9900} = -0.025.$$

ΔR for 1 per cent of carbon dioxide in air under the conditions of the first or normal case is 14.44; the observed reading under the conditions of the third case

is accordingly $\frac{-0.025}{14.44}$ of the 1 per cent, or 0.0017 per cent, too low. When normal air was used as the standard gas each decrease of 1 per cent of oxygen raised the apparent amount of carbon dioxide by 0.172 per cent.

In the cases just cited there was a deficiency of oxygen. The case in which there is an excess of oxygen in the "air" is also met with in practice and is treated in a similar manner. This condition occurs in the analysis of gas from a balloon or airship having an envelope of rubberized fabric. Because of the higher permeability of rubber to oxygen than to nitrogen the "air" penetrating rubber may contain as high as 41 to 42 per cent oxygen.¹¹ This fact should be taken account of in all analyses of gases from balloon envelopes.

Choice of Standard Gas. It may be remarked in passing that the character of the standard gas has no relation to the sensitivity of the interferometer. It merely provides a standard constant refractivity from which differences may be measured. A change of 1 per cent of carbon dioxide in air produces the same difference in scale reading (providing the scale is linear) whether air or carbon dioxide or any other gas is the standard. It makes a great practical difference, however, in convenience and accuracy as to what gas is used as the standard. Take the case of carbon dioxide in air. If 1 per cent of carbon dioxide in air is compared with air as a comparison gas, then Δr , the difference is refractivity between two chambers,

is equal to $\frac{1}{100} \times 1444$ at 20 deg. C. and 760 mm. pressure. If carbon dioxide is used as a comparison gas the difference in refractivity between the two chambers is equal to $\frac{99}{100} \times 1444$. In the first case, a change of 1 per cent in temperature or pressure makes a difference in Δr (see equation 6) corresponding to 0.01 per cent carbon dioxide $\left(\frac{0.14}{14.44}\right)$. In the second case such a change in temperature or pressure makes a difference in Δr corresponding to 0.99 per cent carbon dioxide $\left(\frac{0.01 \times 0.99 \times 14.44}{14.44}\right)$, which is almost as much as the quantity being determined (1.00 per cent).

It is thus apparent that the greatest freedom from error due to changes in temperature and pressure is

secured when the difference in refractivity between the mixture and the standard gas is a minimum. This condition is usually met when the major constituent of the mixture is used as the standard gas; the zero reading of the interferometer then corresponds to a zero difference in optical path between the two tubes.

Analysis of Flue Gas. The interferometer has been suggested and used for the analysis of flue gas. The situation in this case is rather complex because of the number of gases which may be present in the mixture. Usually the percentage of carbon dioxide in a flue gas is determined because it is an index of the proper firing conditions. The flue gas can be considered to be a mixture of carbon dioxide and nitrogen with varying amounts of oxygen, carbon monoxide, hydrogen, methane, and water vapor, depending upon the fuel used, the completeness of combustion, etc. It is interesting to analyze the conditions and show what the error would be with any combination of gases.

The best method of operation, of course, is to absorb the carbon dioxide after passing the gas through one chamber and use the residue as a standard of comparison. Take the case of a furnace gas of the composition shown in Table II. In this example carbon dioxide is the gas sought and the residue after the absorption of the carbon dioxide is assumed to be nitrogen (considering the argon present as nitrogen) with the other gases as diluents. In Table II are tabulated the corrections to ΔR calculated according to equation 9.

TABLE II—CORRECTIONS TO INDICATED PERCENTAGE OF CARBON DIOXIDE FOR A CERTAIN FURNACE GAS

Constituent	Per Cent Present	$\Delta R \times 10^{-7}$	$\left(\frac{ab}{100^2 - 100a}\right) \Delta R \times 10^{-7}$
CO ₂	13.5	CO ₂ —N ₂ = +1498	—
O ₂	2.0	O ₂ —N ₂ = —266	—0.83
CO	4.6	CO—N ₂ = +375	+2.69
CH ₄	0.2	CH ₄ —N ₂ = +1436	+0.45
H ₂	1.4	H ₂ —N ₂ = —1585	—3.46
N ₂	78.3		
Net correction			—1.15

The corrections in the last column are calculated in the manner indicated. The value for the 2 per cent of oxygen, for example, is $\left(\frac{2 \times 13.5}{10,000 - 1,350}\right) \times (-266) = -0.83$. The error in the reading for 13.5 per cent carbon dioxide is $-\frac{1.15}{14.98 \times 13.5} = -0.0057$, or the percentage of carbon dioxide indicated by the interferometer will be $13.5 - (0.0057 \times 13.5) = 13.42$ per cent CO₂. The amount of this correction is entirely negligible in any flue gas analysis. Mohr¹² has analyzed a number of flue gases and found that the percentage of carbon dioxide as determined with the interferometer agreed within the limits of the instrument (0.1 per cent CO₂) with the values found by the usual method of gas analysis by absorption. The errors of the interferometer were of the order indicated by the theory discussed above.

The carbon monoxide and methane in the furnace gas could also be determined by first removing all the carbon dioxide and then oxidizing the carbon monoxide and methane with hot copper oxide. The carbon dioxide formed in the gas mixture could then be determined in the manner just outlined and this percentage would be equal to the sum of the percentage of carbon monoxide and methane originally present.

Kreisinger, Augustine and Ovitz¹³ have found that

¹¹See article by Edwards and Ledig on "The Significance of Oxygen in Balloons," *Aviation Aeron. Eng.* 6, p. 325; 1919.

¹²Mohr, *Z. anorg. Chem.*, 25, p. 1313, 1912.

¹³Bureau of Mines Bull. 135, p. 107; 1917.

the combustible gases in furnace gas, other than carbon monoxide, consist mainly of hydrogen; methane and other hydrocarbons occur only in traces. Furthermore, the carbon monoxide constitutes about 80 per cent of the total combustible gases. These observations are of interest in connection with the subject of flue gas analysis.

Determination of Helium in Mixtures. The interferometer was found useful in the analysis of a sample of helium produced by the fractional liquefaction of natural gas; the details of the analysis are of interest because they illustrate the use of the methods already discussed. From the method of manufacture, the gas was known to consist of helium and nitrogen, with smaller amounts of methane. Tests showed the absence of oxygen in the mixture. Because of the presence of three constituents, the readings of the interferometer alone are not determinate. Accordingly the methane (other hydrocarbons assumed to be absent) was determined in a separate sample by combustion with oxygen over a heated platinum wire; the amount found was 0.2 per cent. The interferometer gave a reading of 1577 scale divisions when the mixture was compared with air. The calibration of the interferometer showed this to be equivalent to a Δr of 2421×10^{-7} at 0 deg. C. and 760 mm. pressure. The refractivity of the mixture is then equal to $2917 - 2421 = 496 \times 10^{-7}$. If x equals the percentage of helium ($R = 342 \times 10^{-7}$) present, then the refractivity of the mixture is also given by the following relation (see equation 3).

$$x(342) + (1.00 - x - 0.002)(2972) + 0.002(4415) = 496, \text{ which gives } x = 0.943$$

The complete analysis is then as follows:

	Per Cent
Helium.....	94.3
Nitrogen.....	5.2
Methane.....	0.2

The analysis made in this way was checked by using the density of the mixture and its constituents in place of the refractivity. This latter method indicated the presence of 94.6 per cent helium in the mixture. The difference is only 3 parts in 1000, which is quite a satisfactory agreement. It is much simpler and quicker, however, to determine the refractivity with the interferometer than to determine the density with the necessary accuracy.

Another sample of helium analyzed in the same manner with the interferometer showed the following composition:

	Per Cent
Helium.....	53.6
Nitrogen.....	34.5
Methane.....	11.9
	100.0

The percentages of helium and nitrogen were also calculated from the density of the mixture and found to be 53.4 and 34.7, which is also a very satisfactory agreement considering the nature of the problem.

SENSITIVITY OF INTERFEROMETER

The sensitivity of the interferometer depends on the length of the gas chambers and certain other constants of the instrument. The Zeiss portable interferometer with 10 cm. tubes indicates about 0.1 per cent carbon dioxide in air for each small scale division. The laboratory type with 100 cm. chambers indicates about 0.01 per cent carbon dioxide. The relative sensitivity of the instrument for different gases is shown in Table III. It is assumed that each scale division indicates

0.01 per cent carbon dioxide. The percentage of other gases in certain mixtures, which is indicated by each scale division, is shown in the last column.

TABLE III—RELATIVE SENSITIVITY OF INTERFEROMETER FOR DIFFERENT GASES

Constituent to Be Determined	Composition of Mixture	$\Delta R \times 10^7$ for 1 p r Cent of Gas at 0 Deg. C. 760 mm.	One Scale Division Indicates per Cent
Carbon dioxide.....	CO ₂ - Air	15.50	0.0100
Methane.....	CH ₄ - Air	14.91	0.0104
Hydrogen.....	H ₂ - Air	15.29	0.0101
Oxygen.....	H ₂ - O ₂	13.18	0.0118
Oxygen.....	O ₂ - N ₂	2.66	0.0583
Nitrogen.....	O ₂ - N ₂	2.66	0.0583
Helium.....	He - N ₂	26.30	0.0059
Acetylene.....	C ₂ H ₂ - Air	30.54	0.0058

Many other interesting cases could be discussed; the present examples, however, are typical of those met with in practice and illustrate the use of the equations and the method of determining the suitability of the interferometer for any specific purpose.

SUMMARY

The principle of the gas interferometer and its method of use in gas analysis are discussed in connection with the calibration of the instrument. The effect produced upon the observations by variations in gas composition and experimental conditions is analyzed and equations developed by which the magnitude of such changes can be estimated. Typical cases in which the interferometer may be employed, such as for the analysis of mixtures containing helium, analysis of flue gas, etc., are given, together with points on sources of error, details of operation and the relative sensitivity of the interferometer for different gases.

House Passes Magnesite Tariff Bill

In passing the magnesite tariff bill, the House has added another to the number of tariff bills pending before the Senate Committee on Finance. The Senate committee has postponed indefinitely the consideration of these bills, and has expressed itself as being unfavorable to piecemeal tariff revision.

The duties imposed in the House bill are $\frac{1}{2}$ c. per lb. on magnesite ore, $\frac{3}{4}$ c. on calcined, dead-burned and grain magnesite and $\frac{3}{4}$ c. per lb. and 10 per cent ad valorem on magnesite brick. The duties imposed are claimed to be so high as to prohibit imports of magnesite, but the Republicans scored a strong point in showing that the increased rate would add only $3\frac{1}{2}$ c. a ton to the price of the finished steel. The bill was passed by vote of 154 to 112.

Silicate Rock Analysis

Analytical chemists will be interested in the fact that a new and revised edition of Dr. W. F. Hillebrand's "Analysis of Silicate and Carbonate Rocks" is in press. Like its predecessors, it will be issued as a bulletin of the United States Geological Survey. Its number will be 700, superseding bulletin 422.

Alpha-Naphthol and Xylidine Mixture as Flotation Agent

In the issue of Oct. 1, Vol. 21, page 418, alpha-naphthylamine should be substituted for alpha-naphthol, which is erroneously stated as a component of the X-cake-xylidine-flotation reagent.

Atomic Structure of Metals in Solid Solution

Experimental Data on Specific Resistance, General Considerations as to Hardness, and the Electronic Theory, All Indicate That Solid Solutions Contain a Large Amount of Supercooled Metal With Liquid or Amorphous Structure

By A. L. FEILD

THE industrial importance of solid solution alloys is too great to be comprehended fully unless consideration is given to the fact that hardened steel and the majority of the alloy steels, of which tungsten, nickel and manganese steels are familiar examples, as well as the common electrical resistance alloys, such as nichrome, manganin and constantan, all belong to this same general class. Any theory, therefore, which offers a reasonable explanation of the mechanism by which the physical properties of these alloys are caused to depart to so great an extent from those of their constituents would appear to be worthy of consideration.

SOLID SOLUTIONS HAVE HIGH SPECIFIC RESISTANCE

The relatively high resistance of alloys which consist of two or more metals in solid solution has not heretofore received a satisfactory explanation. When, for instance, increasing amounts of gold are added to silver to form a series of solid solution alloys, the curve expressing the specific resistance as a function of the composition rises sharply from the value corresponding to pure silver to a maximum and drops sharply to the value corresponding to pure gold. (See Fig. 1, curve A.) On the other hand, for two metals, such as lead and tin, which form a strictly eutectiferous series of alloys, the specific resistance-composition curve is very nearly a straight line.

THE WIEDERMAN-FRANZ-LORENZ LAW AND THE ELECTRON THEORY OF METALS

It is significant that the electron theory of metallic conduction gives no explanation of the peculiar properties of solid solutions. Nor has the electron theory attempted to do so, other than to remark that when solid solution occurs in an alloy neither the electric nor the thermo-electric properties of the alloy are additive functions of the corresponding properties of the constituents; but that, on the contrary, the solid solution behaves in no way similarly to a pure metal, as, for instance, with regard to its failure to comply with the Wiedemann-Franz-Lorenz equation. This equation holds with very considerable accuracy for practically all pure metals, and states, in effect, that the ratio of the thermal to the electrical conductivity multiplied by the absolute temperature is a constant for all metals.

Unfortunately, this law holds only for a narrow range of temperature in the neighborhood of ordinary room temperature, and at both elevated and very low temperatures it has been found experimentally not in accord with the facts in the case. With the electron theory in its present state of development, it is not possible to say more, in the case of the anomalous behavior of solid solutions, than that in such a case the volume concentration of free electrons is greatly diminished, or the number and distribution of the attracting centers are altered, or a change occurs in the variation of

the attracting force with distance, or else that the characteristic behavior is the resultant of some combination of these factors and their temperature functions.

Obviously, such an explanation does not elucidate the problem to any noticeable degree. We do know, however, that in general the effect of adding to a pure metal some other metal with which it forms a solid solution is to decrease the electrical conductivity relatively to a greater extent than the thermal conductivity. In the light of what follows it is seen that this phenomenon is due to the fact that with increasing temperature the electrical resistance of a pure metal decreases more rapidly than does the thermal conductivity.

It is true that the theory has predicted correctly, in the case of a series of solid solution alloys, that the characteristic shape of the resistance-composition curve would be reflected in the curve of thermo-electromotive force versus composition, since both conductivity and thermal e.m.f. are dependent upon the electron distribution within the material.

On the other hand, the same reasoning would lead one to look for a sharp break or discontinuity in the thermo-electric power of a metal on passing from the solid to the liquid state, corresponding to the observed phenomenon in the case of the property of electrical resistance. So far, however, no such break in the thermo-electric properties at the melting point has been observed.¹ Lord Rayleigh's² hypothesis as to the existence in alloys of a

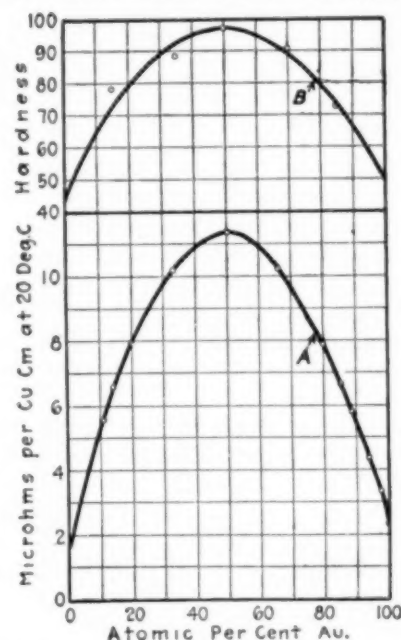


FIG. 1. COMPOSITION CURVE OF Ag-Au ALLOYS, FROM MEASUREMENTS BY MATTHIESSEN
A—Specific resistance-composition curve of Ag-Au alloys. B—Hardness-composition curve of Ag-Au alloys.

false resistance arising from a Peltier e.m.f. at the junctions between the constituents of the alloy cannot be applied to solid solution alloys, where, as is known, the intermingling of these constituents is actually molecular in its nature, and because, in the case of eutectiferous alloys where it should certainly

¹See P. Cermak and H. Schmidt, *Ann. Physik*, vol. 36, pp. 575-88 (1911).

²*Nature*, vol. 54, p. 154 (1896).

apply, the observed deviations from linearity in the resistance-composition curve are of a very small magnitude and not entirely inexplicable on different grounds.

DISCONTINUITY IN ELECTRICAL PROPERTIES AT MELTING POINT

In the case of the common metals the specific electrical resistance is roughly proportional to the absolute temperature. This law holds with fair accuracy in the temperature range 0 deg. to 100 deg. C., but the observed deviations become more prominent as the temperature increases. In metals, such as iron, which undergo allotropic changes, there occur at the transformation points corresponding changes in the temperature coefficient of resistance. On fusion, there occurs in general a discontinuity in the resistance-temperature curve, the liquid metal having usually from two to four times the resistance of the solid metal at the melting temperature. The proportionality between the electrical conductivity of pure metals in the crystalline solid state and the absolute temperature must be considered as only a very rough approximation. For a "perfect" metal the temperature coefficient of resistance is equal to $\frac{1}{273}$, or 0.00366, reckoned from the value of resistance at 0 deg. C. Actually, the temperature-coefficient of most metals is greater than this.

In marked contrast to the metals in the solid state, the temperature coefficient of molten metals, reckoned from the melting temperature, is in practically all cases very much less than 0.00366. This fact, together with the abrupt increase in specific resistance on fusion, is sufficient to cause the resistance-temperature curve, extrapolated down to room temperature, to lie at a very considerable distance above the observed resistance-temperature curve of the solid metal, as shown schematically in Fig. 2, in which the dotted line would represent the electrical property of the amorphous solid metal.

CRYSTALLIZATION PROCESS IN SOLID SOLUTIONS

It is known that when a pure metal crystallizes from its melt there occurs a rearrangement of the atoms which results in the establishment of some definite configuration. If by suitable means a molten metal could be cooled below its melting point without rearrangement of its atomic structure, we would have a phenomenon too well exemplified in the case of the glasses, silicates, etc., to call for any detailed explanation here. A definite crystalline configuration would not appear, and with the exception of the property of viscosity the cooled melt would be similar in its properties to a liquid, or, in other words, it would be an amorphous solid. In the case of the common metals in a state of purity the formation of the amorphous solid phase by rapid cooling alone is not possible, due to the very great crystallizing power of these substances. Assuming, however, that supercooling sufficient to give the solid amorphous phase were possible, the question naturally arises as to what would be its most probable electrical properties. Reasoning from what information we have regarding certain of the other physical properties of supercooled liquids such as vapor pressure, we will hypothecate no break to exist at the melting point between the temperature-resistance curve of the liquid metal and that of the supercooled liquid or amorphous solid metal, and that the latter will possess likewise the same temperature coefficient of resistance

as the molten metal. For example, nickel,³ with a temperature coefficient at its melting point (1452 deg. C.) of 0.000167 and a specific resistance at this temperature of 108 microhms per cu.cm. would be expected to show in the amorphous solid form at 20 deg. C. a specific resistance of 108 $[1 - (1430 \times 0.000167)]$, or 92.9 microhms per cu.cm. The computation is equivalent to an extrapolation of the resistance-temperature curve of the liquid metal down to ordinary temperatures.

Now, while we are unable by cooling alone to produce such a metal in the amorphous solid form, it is a well-known fact that by the addition of a certain amount of some such metal as chromium, capable of forming a continuous series of solid solutions⁴ with the nickel, the crystallization process at the melting point is very

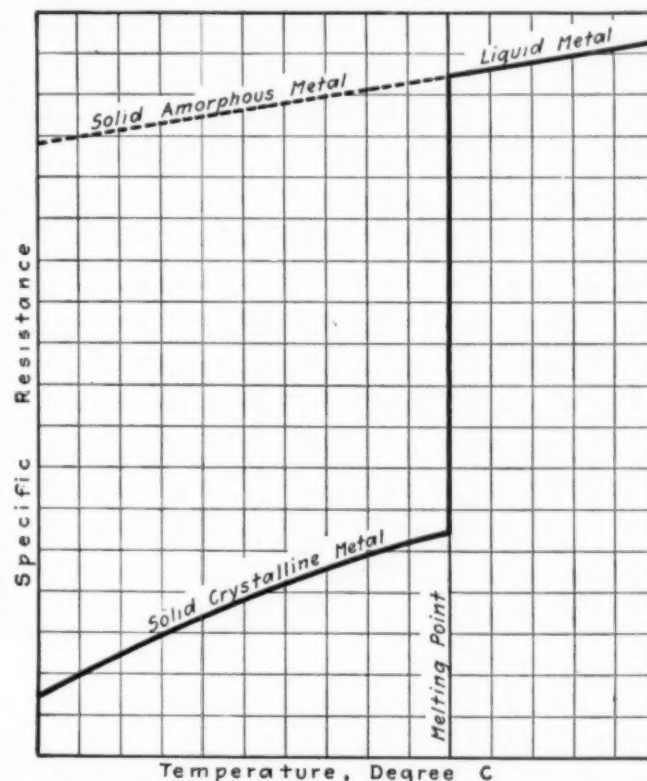


FIG. 2. ILLUSTRATIVE EXAMPLE OF SPECIFIC RESISTANCE-TEMPERATURE CURVES OF A PURE METAL

greatly modified. If we consider the chromium primarily as an agent for the preservation of the molecular structure of the molten metal in the solid metal we would expect to find that the resulting nickel-chromium alloy would show a very high resistance, approximately equal to 92.9 microhms per cu.cm., and that its temperature coefficient would be small, about equal to 0.000167. The confirmation which this theory receives from the known data⁵ regarding nickel-chromium alloys is rather remarkable. A Ni-Cr alloy containing 20 per cent Cr has a specific resistance of 96.9 ohms per cu.cm. and a temperature coefficient of 0.00012 reckoned from room temperature.

Let us examine another well-known pair of metals known⁶ to form a continuous series of solid solutions viz., silver and gold. According to Matthiessen⁷ the

³K. Bornemann and G. von Rauschenplat, *Metall.* 9, 473, 505.

⁴G. Voss, *Z. anorg. Chem.*, vol. 57, pp. 34-71 (1908).

⁵M. A. Hunter and F. M. Sebast, *Rensselaer Polytechnic Inst., Engineering and Science Series*, No. 10; *J. Inst. Metals*, vol. 11, pp. 115-38 (1917).

⁶W. C. Roberts-Austen and T. Kirke Rose, *Proc. Royal Soc.*, vol. 71, p. 161 (1903).

⁷A. Matthiessen, *Pogg. Ann.*, 110, pp. 190-234 (1860).

resistance-composition curve of this system has a shape typical of solid solutions. (See Fig. 1, curve A.) The highest value for specific resistance is equal to 11.42 microhms per cu.cm. at about 20 deg. C. Fortunately, the specific resistance and temperature coefficient for both silver and gold have been determined in the liquid state at their melting points. Northrup⁸ finds that liquid silver at its melting point (960.5 deg. C.) has a resistance of 16.6 microhms per cu.cm. and a temperature coefficient reckoned at this temperature of 0.00069; while liquid gold has a resistance of 30.82 microhms

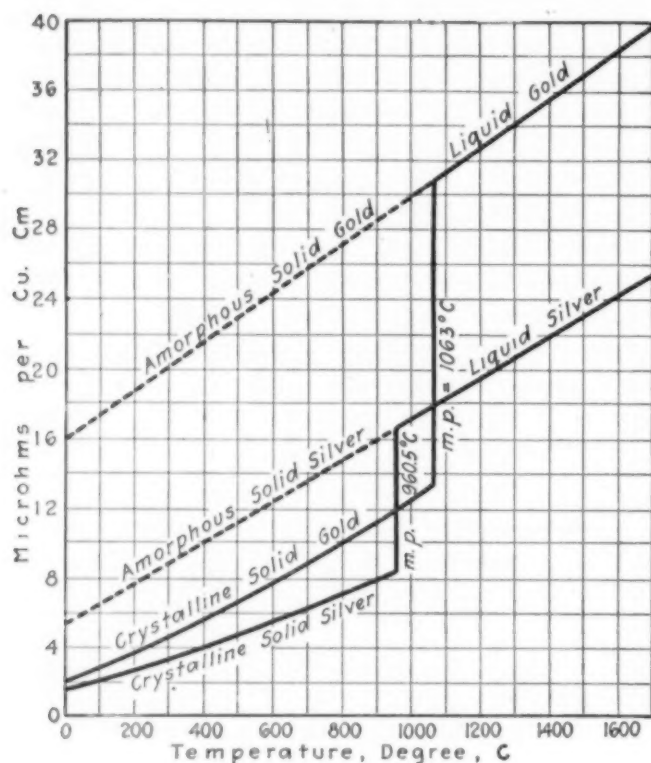


FIG. 3. TEMPERATURE-RESISTANCE CURVE FOR GOLD AND SILVER, SOLID AND LIQUID (ACCORDING TO NORTHROP)

Dotted line represents electrical properties of amorphous solid gold and silver, according to theory advanced by the author.

per cu.cm. at its melting point (1063 deg. C.) and a temperature coefficient of 0.000459. Making our computations as before, we find that the specific resistance of "amorphous solid silver" at 20 deg. C. is calculated to be 5.29 microhms, and that of amorphous solid gold 16.09 microhms. (Fig. 3.) The mean of these two values is equal to 10.69 microhms, which checks very well with the observed value of 11.42 microhms. It appears then that the agreement between the calculated and observed values in the case of the system Ni-Cr discussed above may rationally be explained as due to the fact that the calculated value for amorphous solid chromium at 20 deg. happens to be about equal to that for nickel, a hypothesis not unlikely when taken in connection with the close atomic resemblance between the two metals.

Similar calculations can be made in the case of the system gold-copper, which has been shown⁹ to form a continuous series of solid solutions. The resistance of molten copper at its melting point (1082.6 deg. C.)

is given by Northrup⁸ as 21.30 microhms per cu.cm. with a temperature coefficient of 0.000381. The calculated resistance of amorphous solid copper at 20 deg. C. is equal to 12.67 microhms per cu.cm. The mean between this value and that of gold as previously arrived at, viz., 16.09 microhms, is equal to 14.38 microhms. According to the measurements of Matthiessen the maximum resistance at about 20 deg. of solid Au-Cu alloys is equal to 14.49 microhms per cu.cm. The agreement is correct to within less than 1 per cent.

The only remaining system for which the data needed for our calculations are available is the system Cu-Ni.¹¹ The mean of the values already given for the resistance of these two metals in the amorphous solid form is

$$\text{equal to } \frac{12.67 + 92.9}{2} = 52.78 \text{ microhms per cu.cm.}$$

According to the measurements of Fuessner and Lindeck¹² the specific resistance of the Cu-Ni alloy of maximum resistance is equal to 52.05 microhms per cu.cm. Table I contains a summary of the data for the four systems under consideration. The computation for the system Ni-Cr is included, although, to make it strictly comparable with the rest, it must be assumed that the specific resistance of solid amorphous chromium is approximately equal to that of nickel.

TABLE I.

Comparison of the observed values of maximum resistance at 20 deg. C. of the systems Ni-Cr, Ag-Au, Au-Cu and Cu-Ni with the mean of the resistances of the amorphous solid components, obtained by extrapolation of the observed resistance-temperature curves of the components in the liquid state down to 20 deg. C.

System	(Values of resistance in microhms per cu.cm.)			
	Calculated Resistance of First-Named Metal in Amorphous Form at 20 Deg.	Calculated Resistance of Second Metal in Amorphous Form at 20 Deg. C.	Mean Value Calculated	Maximum Observed for Solid Solution
Ni-Cr	92.9	92.9 (assumed)	92.9	96.9
Ag-Au	5.29	16.09	10.69	11.42
Au-Cu	16.09	12.67	14.38	14.49
Cu-Ni	12.67	92.9	52.78	52.05

It would be expected that in the case of those alloys which form a simple eutectiferous series of alloys there would be no close agreement between the observed values and those calculated as above. The system Cu-Ag is an example of this. The calculated resistance in this case for the alloy of maximum resistance is equal to 8.98 microhms per cu.cm., whereas Matthiessen has obtained a value of 10.40 microhms by actual measurement.

CRYSTALLIZATION AN ELECTRONIC PHENOMENON

If it be found generally true then that the relationships to which attention has been called are exhibited by all those systems of metals which form solid solutions with one another, while on the contrary these relationships do not exist in the case of simple eutectic systems, then it is certain that the atomic processes operating during the passage of the melt from the solid to the liquid state, whether the former state be that of a crystalline or an amorphous solid, are governed entirely by the electrical properties of the atoms, which properties are determined, as we know, by the number of free electrons present and the distribution of their potential energy. The crystallization

⁸E. F. Northrup, *J. Frank. Inst.*, vol. 177, pp. 286-92; vol. 178, pp. 85-87 (1914).

⁹N. S. Kurnakow and S. F. Zemczuzny, *Z. anorg. Chem.*, vol. 54, p. 149 (1907).

¹⁰E. F. Northrup, *J. Frank. Inst.*, vol. 177, pp. 1-21 (1914).

¹¹W. Guertler and G. Tammann, *Z. anorg. Chem.*, vol. 52, p. 25 (1907).

¹²*Wissenschaftl. Abhandlungen der Phys. Techn. Reichsan.*, vol. 2, p. 510 (1895). The value used was obtained from a curve, and may be in error by 1 per cent or so.

process in metals, therefore, is an electronic phenomenon, and is not then very greatly removed in its nature from ordinary chemical reactions in which the electron structure is known to be the decisive factor.

A solid solution may then be regarded as entirely analogous to a supercooled liquid, preserving in the solid state all of the electrical properties, such as specific resistance and temperature coefficient of resistance, of the molten mixture of components. We are then at liberty to dispense with the theory that the high resistance of solid solution alloys is due to internal strain or to the closeness of packing of the atoms. Those facts which will explain the high resistance of the molten constituents will also explain the high resistance of solid solution at ordinary temperatures. Internal strain in liquid metals is hardly conceivable.

METALS OF APPROXIMATELY EQUI-ATOMIC VOLUME CONSIDERED IN TABLE I.

The agreement between the calculated and the observed values of resistance, as given in Table I, is so remarkably good that it leads us to inquire why the mean of the resistances of the components in the amorphous solid state should agree with the observed maximum resistance of the alloy. If the property of specific electrical resistance of the alloy were simply an additive function of the respective specific electrical resistances of the pure components, computed as being entirely in the solid amorphous state, then in binary systems, such as have been considered, we would expect the resistance-composition curve to be a straight line. It is certain then that is not the case. On the other hand, if the percentage of amorphous solid silver, say, in the system silver-gold is a function of the amount of silver (or gold) present in the alloy, we would obtain a resistance-temperature curve similar to that observed. It is indeed reasonable to suppose that the addition, say, of only 2 per cent gold to liquid silver is unable completely to inhibit the crystallization processes, or the rearrangement of atomic configuration, but that the inhibition increases rapidly as the percentage of added gold increases. If those forces brought into play to prevent atomic rearrangement at the melting point are essentially of interatomic nature, we would expect a maximum inhibition of crystallization when the atoms of the two metals were present in equal atomic proportions. The observed maximum of resistance should then correspond to equi-atomic percentages of the components. Since specific electrical resistance is referred to unit volume, the agreement between the observed and calculated values as shown in Table I indicates that the atomic volumes of each of the components of a binary solid solution system must be very nearly the same. The smaller the difference between the specific resistances of the two pure components in the amorphous solid form the greater can be the permissible variation between the atomic volumes of the components for a given difference between the observed and the theoretical values. (The term atomic volume refers here to the metal in the amorphous solid form, and will differ somewhat from the ordinary values for crystalline solids.) It is, of course, a well-known fact that, in general, the maximum in the resistance-composition, and also of the hardness-composition curve, occurs at very nearly equi-atomic percentages; and furthermore it is also recognized that solid solution is most common in pairs of metals having approximately the same atomic volume in the crystalline state.

There is, as has been indicated, a close connection between the hardness and electrical resistance of solid solution alloys, the general shape of the hardness-composition and resistance-composition curves being similar, and the maximum on each curve occurring at practically the same composition. (See Fig. 1, curve B.) According to our theory hardness in such an alloy is due to the existence of the metal in the amorphous solid state, thus confirming essentially Beilby's theory of the formation of an amorphous phase during cold-working of a metal.

In accordance with this view, gamma-iron is simply amorphous solid iron which is in solid solution with carbon. It should be similar in its electrical properties to molten iron. There can hardly be any basic difference between gamma-iron and the iron held in solid solution in manganese, nickel or tungsten steels. The high electrical resistance in both cases is evidence sufficient to place them in the same broad class which includes the four solid solution systems above mentioned, in spite of the fact that, particularly in the systems containing carbon, we may have solid solutions capable of transformation into the mechanical mixture characterizing eutectiferous alloys by a suitable heat treatment, or by slow cooling alone. If the resistance of liquid iron at its melting point were known, it would be possible from this value, together with the observed maximum resistance of chilled carbon steel of austenitic structure, to calculate the resistance of solid amorphous carbon of zero porosity. This information might be of considerable interest when compared with the observed resistance of different types of carbon and graphite.

Returning to the question of the hardness of metals and the formation of an amorphous phase, it is possible to make an estimate of the amount of solid amorphous phase present in pure metals in the hardened state from the observed resistance of hardened as compared with that of annealed specimens. The calculations carried out for Ag, Cu and Ni, using Broniewski and Rauschenplat's¹⁵ measurements of electrical resistance of the hardened and annealed metals, are, in percentages of the amorphous solid metal: Ag 1.18 per cent, Cu 0.21 per cent and Ni 1.38 per cent. A very small amount of the amorphous metal is therefore able to account for the observed increase in electrical resistance on hardening.

DISCUSSION OF ANOMALOUS INSTANCES

The case of bismuth is peculiar. The resistance of annealed and of hardened electrolytic bismuth is respectively 107.5 and 126.3 microhms per cu.cm. at 0 deg. C., while that of solid amorphous bismuth at this temperature is equal to 109.4 microhms, using the measurements of Northrup and Suydam¹⁶ on molten bismuth. Hence it is difficult to explain the observed increase in electrical resistance on hardening unless we assume that at its melting point bismuth undergoes an allotropic change. This is in accord with the present ideas regarding this metal, which, as is well known, undergoes a decrease in resistance on melting instead of an increase, the only other metal which acts similarly being antimony. It might be added that these two metals form with each other a continuous series of solid solutions.

¹⁵Loc. cit.

¹⁶E. F. Northrup and V. A. Suydam, *J. Frank. Inst.*, 175, pp. 153-61 (1913).

The evidence brought forward in the present paper that the high electrical resistance of solid solution alloys is due to the retention in the solid state of the atomic structure of the liquid state would seem to establish the fact that the hardening of pure metals as well as the increased hardness of solid solutions over that of the pure components is due to the presence of amorphous solid metal. Hardening occurs when the metal is sheared beyond the elastic limit, and presumably during the time when flow occurs a certain portion of the metal is actually in the liquid state. In the case of such metals as lead, thallium and tin the transformation of the amorphous solid metal resulting from the rapid freezing of the liquid metal to the original crystalline metal occurs very rapidly and is completed within a short time. In the case of copper and nickel, for instance, the transformation of the amorphous phase to the crystalline is not complete. A dynamic equilibrium is finally set up during continuous cold working whereby the same amount of amorphous metal is converted to crystalline as is formed by the shearing processes.

It is unnecessary to call attention to the need of more complete data on the electrical resistance in the

liquid state of those metals which are able to form solid solution alloys, and also on the electrical resistance of their different alloys. Particularly in the case of Pt, Pd, Fe, Cr, Mn, Bi and Sb this information would be of much value in obtaining additional confirmation for the theory herein advanced. In the case of the metals Fe, Mn, Cr, V, Ti and Si experimental determinations of the specific resistance in the liquid state over a range of temperature would probably yield information of very great importance to the science of metallurgy and metallography, especially in so far as iron and steel is concerned. The use of electrical methods for investigating the properties of metals is older than either the thermal or the microscopic method. Assuming that we are able to grasp completely the essential principles underlying the electrical properties of metals—and it is believed that the theory advanced in the present paper is a step in the right direction—it can be predicted that the electrical method of examination will eventually become a very powerful instrument of industrial research and control, possessing also enormous possibilities from the purely scientific standpoint.

Cleveland, Ohio.

Hygroscopicity of Trinitrotoluene*

BY WILBERT J. HUFF

THE application of trinitrotoluene to the arts of peace is a matter of much interest and importance just now because of the huge stores of that material rendered available by the signing of the armistice. As an argument against such use it has been stated that trinitrotoluene is very "hygroscopic" (hygroscopic?) and that if used in place of dynamite for land clearing or drainage, extreme care must be exercised to keep it dry.¹

CALCULATED HYGROSCOPICITY

The allegation that trinitrotoluene is hygroscopic is, upon analysis, a most surprising one. The hygroscopicity of a crystalline compound not forming hydrates is determined by the vapor pressure of the saturated aqueous solution of the compound and the partial pressure of water in the surrounding atmosphere. While no measurements of the vapor pressures of saturated solutions of trinitrotoluene appear to be available, their order of magnitude may be readily calculated. The solubility of trinitrotoluene in water at 15 deg. C. is 0.021 per cent and at 100 deg. C. is 0.164 per cent.² Assuming the temperature-solubility curve to be linear (without introducing any appreciable error) and applying Raoult's law, the vapor pressure of such a solution at 25 deg. C. is 99.997 per cent of that of pure water at the same temperature. Since these, then, are almost equal, it follows that trinitrotoluene is practically not hygroscopic. It may be of interest to note that its hygroscopicity must be multiplied 2300 times to become equal to the hygroscopicity of potassium nitrate and 6900 times before it is necessary to pack it in paraffine-protected containers.³

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¹"Clearing Land with TNT," p. 4, Industrial Section, *Bulletin*, American Institute of Mining Engineers, March, 1919.

²Marshall, "Explosives, Their Manufacture, Properties, Tests and History" (1915 ed.), p. 571.

³Cf. Marshall, *loc. cit.*, p. 340.

The conclusion that trinitrotoluene is practically not hygroscopic is supported by the following statement from Molinari and Quartieri: "Il se conserve parfaitement inaltéré a l'air sec ou humide (son hygroscopicité est seulement de 0.05%) . . ." "It remains completely unchanged in dry or moist air (its hygroscopicity is only about 0.05%)."

LABORATORY DETERMINATIONS

Since three grades of solid trinitrotoluene are used in America, and because small quantities of water soluble impurities would affect their hygroscopic properties, it was deemed advisable to seek experimental confirmation by laboratory measurements of samples of the lower grades, using the method developed in this laboratory by Taylor and Cope.⁴

The only modification was the introduction of an inverted porcelain crucible cover, 3.4 cm. in diameter, 0.3 cm. in depth. The sample was spread uniformly over this and the whole then placed inside a slightly larger porcelain crucible.

To check the conditions used, the rate of moisture absorption by pure potassium perchlorate was determined at 25 deg. C. The results obtained are compared below with those previously determined by Taylor. The agreement is quite satisfactory.

The trinitrotoluene used was of two different grades, as follows:

	Grade II.	Grade III.
Manufacturer.....	Canadian Explosives, Ltd.	Hercules Powder Co.
Brand.....	Grade 2 TNT	76 deg. C. TNT, Grade III
Received from.....	Picatinny Gen. Ord. Depot	Raritan Arsenal
Laboratory No.....	M-2321	M-2328
Solidification point.....	80.3 deg. C.	76.5 deg. C.
Moisture.....	0.02 per cent	0.08 per cent
Insoluble matter.....	0.156 per cent	0.04 per cent
Ash.....	0.008 per cent	0.014 per cent
Acidity (H ₂ SO ₄).....	0.002 per cent	0.014 per cent
Color imparted to water	Pale straw	Pale straw to rose

This was carefully dried in a vacuum desiccator, then 2.0000 g. weighed into the crucible, allowed to stand for 24 hr. over concentrated sulphuric acid, reweighed

⁴Notices sur les explosifs en Italie—E. Molinari and F. Quartieri, p. 167, Milan, 1917.

⁵Guy B. Taylor and W. C. Cope, *MET. & CHEM. ENG.*, XV, pp. 140-143 (1916).

and then exposed to an atmosphere saturated with water vapor at 25 deg. C. in accordance with the method of Taylor and Cope. The results are given in Table I.

TABLE I—APPARENT RATE OF MOISTURE ABSORPTION IN A SATURATED ATMOSPHERE AT 25 DEG. C.

Material	Hours	Grams Moisture Taken Up
KClO ₄	17	0.0070*
	41½	0.0190*
	65	0.0238*
KClO ₄	24	0.0085
	45½	0.0200
	74½	0.0267
Grade II. TNT.....	24	0.0104
	52½	0.0202
	74½	0.0286
(Run of the sample).....	98	0.0339
	121½	0.0324
	144½	0.0450
Grade III. TNT.....	23½	0.0105
	51½	0.0142
	74½	0.0229
(Run of the sample).....	96	0.0171
	118½	0.0163
	144½	0.0240
Grade III. TNT (Washed with distilled water, and screened to pass 30 mesh—then carefully sampled).....	25	0.0085
	46½	0.0080
	73½	0.0162
	95½	0.0199
	125½	0.0217
Ground glass (35 to 45 mesh).....	147½	0.0203
	26½	0.0230
	48½	0.0369
Empty crucible.....	69½	0.0375
	27	0.0100
	22	0.0115
	21½	0.0110

* Taken from "The Hygroscopic Properties of Black Powder," by Dr. G. B. Taylor.

While the gains in weight observed are extremely small, they are of the same order of magnitude as that found for potassium perchlorate.

Now the calculated vapor pressure of saturated solutions of potassium perchlorate at 20 deg. C. is 99.7 per cent of that of pure water.* Theoretically, then, potash sium perchlorate should deliquesce about 100 times more rapidly than does trinitrotoluene. At first glance, the experimental results seem to contradict this and suggest the presence of water-soluble impurities in the trinitrotoluene. To remove any such impurities a quantity of Grade III trinitrotoluene was twice washed by melting it and agitating it for 1 hr. under five times its volume of distilled water. The tests upon this still show gains of approximately the same magnitude.

Tests made with empty crucibles and with crucibles containing 3.0000 g. of carefully washed and dried ground glass (35 to 45 mesh) show conclusively that the gain in weight is due almost entirely to thin films of water deposited on the surfaces of the crucibles and material. This deposition is probably caused both by surface adsorption and by condensation attending the minute but inevitable temperature fluctuations in the thermostat.

The method of Taylor and Cope, therefore, appears to be unsuited for the determination of hygroscopicities less than that of potassium perchlorate.

The experimental results do show, however, that trinitrotoluene is practically non-hygroscopic and are herewith published to controvert the current misleading statements to the contrary.

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Bureau of Mines, Pittsburgh, Pa.

* Marshall, loc. cit., p. 341. The experimental data of Taylor and of Cope and Taylor at 25 deg. are in accord with this calculated value.

Zinc Industry In Belgium*

BY MARCH F. CHASE

BELGIUM for many years was the principal zinc producing country of the world. Gradually its production was surpassed by that of Germany, and Germany in turn lost first place by the production in the United States. For the ten years previous to 1914, 21.6 per cent of the world's zinc was produced in Belgium. Of this production approximately 40 per cent was exported. A large percentage of the balance was rolled and of the sheets thus produced a considerable quantity was also exported.

From an economic standpoint even before the war, the Belgian zinc industry was in a unique, if not precarious, position. Dependent upon foreign countries for ore and foreign markets for sale of products, the Belgian smelter was at a distinct disadvantage when compared with some of those of other localities. These disadvantages were partly offset by cheap coal and labor and by whatever there is of value in experience and what we may term for want of a better expression "smelting tradition." However intangible this latter may be, it did have and has today an influence on commercial operations.

One must not overlook the effect it will have on the revival of the industry. It may not be the determining factor, but the fact that for so many years this industry flourished in Belgium and played such an important rôle in the industrial life of the country will decide many operators to attempt to re-establish their operations.

In 1913 the Belgian zinc plants produced 204,220 long tons of zinc, or approximately 20 per cent of the world's production. During that year 500,000 tons of ore were treated. The actual value of all of the products derived from treating zinc ore amounted to 225 million francs. In 1918, the production had dropped to 8,000 tons with a corresponding drop in the value of the products.

The general custom in Belgium has been to roast zinc ores at chemical works and then transport the roasted ore to the smelting plants. Only 4 out of the 14 smelting plants have roasting plants attached. The total capacity of these 4 smelter roasting plants was 100,000 tons of ore per year. There were 10 chemical works having a zinc ore roasting capacity capable of treating somewhat over 300,000 tons a year. Because of obtaining such a large amount of Australian ore, it is quite natural that the development of the smelting practice should have been along the lines of recovering the lead and silver values from the furnace residues. Two plants were equipped to treat the residues producing lead and also refined silver.

Table I gives the record of operations for the years 1913 to 1918.

TABLE I. YEARLY PRODUCTION OF ZINC IN BELGIUM, 1913-18

Year	Number of Retorts	Number of Workers	Tons of Coal	Ore Used, Tons	Zinc Produced, Tons
1913	43,434	8,539	998,655	488,730	204,220
1914	30,765	8,142	715,815	340,700	145,925
1915	10,448	4,397	262,020	124,890	51,664
1916	5,182	4,044	142,020	59,750	22,930
1917	1,898	1,586	.....	.....	10,296
1918	1,000	.....	.....	.....	8,000

During the 53 months of the war there was produced 34,000 tons of sheet zinc.

The principal source of ore was Australia. In 1913,

*Bureau of Mines Minerals Investigations Series, No. 18.

out of a total of 495,760 tons of ore used, 840 tons came from Belgium, 488,035 from foreign countries, of the foreign ore, 175,000 came from Australia.

and 6895 from oxide and refuse. Of the 480,000 tons Official published figures of the Department of Mines of Belgium for 1913 show that in that year there were 14 plants, with 43,253 retorts; the number of workers was 8444; and the production was 205,940 tons. There were 10 rolling mills, with 34 rolls and 742 workers. The production was 49,120 tons.

Most of the companies obtained their ore through German brokers. Only one company had any direct supply of its own. The fact that the ore was furnished in this way, with the control of the metal lodged more or less completely in the hands of the interests furnishing the ore, has certainly not contributed to a rational development of the industry.

In addition to the Australian ore, one company imported a considerable tonnage each year from Sweden and from Sardinia. The Swedish ore will undoubtedly continue to go to Belgium. The freight rate at the present time from Sardinia is so excessive, being as high at times as £7 sterling, that it is problematical whether much of this ore can be used; although the freight rate from Australia is also high, ore from there carries lead and silver values, so that it can better stand the advanced rates.

The only ore supply in sight for Belgian smelters at present, outside of Sweden, is Australia, with a possibility in the future of getting some ore from Mexico, as with the return of conditions approaching those of the pre-war period the Belgians may be able to compete in the Mexican ore market.

NAPOLÉON GAVE SUBSIDIES FOR EXPERIMENTAL WORK

The present method of zinc distillation originated in the city of Liège, where the ores from Moresnet, the former neutral territory between Germany and Belgium, were treated. The original experimental work was paid for by subsidies granted by Napoleon I. An interesting historical account of the first attempts to produce zinc from these ores is given in one of the recent reports of the Vieille Montagne Co. This company controls the mines at Moresnet, and until the outbreak of the war was the largest producer in Belgium and one of the largest in the world, having a yearly production from all plants of over 100,000 long tons. For the last hundred years, Liège has always been the principal smelting district in Belgium. The works in this district are for the most part on the Meuse River and obtain their coal from the Liège field, having both rail and water transportation from the mines to the plants.

The only lead furnaces in the Liège district were at the Dumont Frères plant. These furnaces were completely destroyed. Aside from quite an extensive installation at Overpelt, which included, in addition to the lead furnaces, silver-refining furnaces, the rest of the lead smelting is done in the eastern part of the country.

The roasting plants, except those of Prayon and Dumont, are near the seaboard, and the roasted ore is carried by canal boats to the smelting works. The country is so small that the internal transportation cost has never been much of an item, but in order to effect every saving possible, zinc smelters have taken advantage of the highly developed waterway facilities of the country.

There are 14 smelting plants with a total of 50,696 retorts, 10 rolling mills, with a combined capacity of

52,000 tons, and 10 chemical plants for roasting ores. Detailed data are given in Table II.

TABLE II. LOCATION AND CAPACITY OF BELGIAN SMELTERS AND ROLLING MILLS

Smelters		
Name of Company	Location of Plant	Retorts
Austro-Belge	Corphalie	2,200
Biache-St. Vaast	Ougree	1,000
Boom	Boom	1,600
Dumont Frères	Sclaignaux	6,000
Lamaine	Antheit	2,304
Nouvelle Montagne	Ensis	3,200
Overpelt-Lommel	Overpelt	2,684
Overpelt-Lommel	Lommel	2,568
Pennarroya	Bleyburg	1,700
Prayon	Foret	3,840
Rothen	Rothen	3,360
Vieille Montagne	Angleur	5,440
Vieille Montagne	Flone	4,000
Vieille Montagne	Vallentin-Coeq.	10,800
		50,696
Rolling Mills		
Name of Company	Location of Plant	Capacity, Tons
Overpelt-Lommel	Overpelt	6,000
Prayon	Foret	6,000
Vieille Montagne	Angleur	18,000
Vieille Montagne	Tilff	10,000
Vieille Montagne	Vallentin-Coeq.	3,500
Ancipre, Alfred	Foret	1,700
Lejeune Frères	Vaux	300
Liège	Chénée	3,500
Heptin-Hauseur	Fraipert	3,000
		52,000

LARGE FURNACES NOT FAVORED

About 60 per cent of the smelting capacity can be said to be of modern construction. A plant at Rothen, with 3360 retorts, was completed just before the war, and one at Corphalie, with 2200 retorts, was built during the war. The tendency in the newer plants has been to increase to a considerable extent the mechanical handling of ores and also the mechanical charging and discharging of the furnaces. The Belgian engineers have never looked with favor on the use of the large furnaces so common in this country. The furnace generally used is one that has not over 200 retorts to the side, and it is only in the recently built plants that one finds the separate producers used, and in only a limited number have mechanical producers been used. The working floors of the furnace rooms are well ventilated and the hoods over the furnaces are connected with stacks for carrying away the zinc fumes from the furnaces.

The furnace blocks, as stated, are small and in all but one plant are placed end to end with considerable distances between the ends of adjoining furnaces. One plant recently constructed has compartment furnaces of the regenerative type, with separate air control in the different compartments of the furnaces. This type of furnace is much commended and will most likely be adopted in future rebuilding of furnaces.

The general character of building with one or two minor exceptions compares favorably with the more modern smelters in the United States. The ground space used per unit of capacity is considerably less than in this country. While the actual construction is of a permanent and substantial character, a number of the plants are poorly arranged and equipped, so that with high priced labor the smelting costs of these particular plants are apt to be much beyond a figure that will be obtained in British and American works.

The practice in regard to roasting has been to use hand-raked furnaces, only two attempts having been made to depart from this rule. At one plant five Spirlet furnaces were put up and at another plant a modified Hegler is now under construction.

While the mechanical or semi-mechanical roasting

furnaces used in this country have not been entirely successful, still they do use less labor per ton of ore roasted than the hand-raked furnaces, and with increasing cost of labor the Belgian plants will be at a serious disadvantage, even after allowances are made for lower fuel consumption and smaller dust losses. The latest installation of roasting furnaces was that put in at the Coleman chemical plant just before the outbreak of the war. These furnaces are of the Delplace type and were operated for a short time only, as during the war the acid works at this plant used pyrite as a source of sulphur. In the last days of fighting, in November, 1918, this plant was completely wrecked. The furnaces themselves were not destroyed, but the lead chambers and other parts of the plant were greatly damaged, not only through shell fire but through removal of equipment and material.

FUTURE OF THE INDUSTRY NOT BRIGHT

The principal reason for the extensive smelting of zinc ores in Belgium was the fact that the country had an abundance of cheap and skilled labor, the proper quality of clay for retorts, cheap coal and cheap water transportation. Of these four factors, probably the most important was that of labor. The past four and a half years of enforced idleness, together with the removal of many of the workers from towns near the smelting plants, has resulted in a thorough disorganization and demoralized condition of labor, and its effect will be felt for some time in the industry, both in respect to the efficiency of the operations and also in the labor cost. The future of Belgium as a zinc-producing country is not particularly bright, but the relative position it will occupy from now on is not easily predicted.

It is rather certain that for some years to come production will be far below the pre-war figures and may never reach the 1913 level. The rehabilitation of the industry even to a limited extent will depend upon the obtaining of prompt and reasonable supplies of ore. If these are not promptly provided, the greatest asset that Belgium had, that is, the skilled workmen, will be lost, as these men undoubtedly will seek employment either in other countries or in other industries. The smelting capacity outside of Belgium has been so vastly increased that it can easily take care of the world's requirements and only the plants that are in a position to operate on low cost and high recovery can hope to compete successfully. The present cost of coal will no doubt come down, but the political and commercial control of the primary raw material, being outside of Belgium, will always work against the continuance of the industry. One factor that will be helpful, however, will be a profitable market for the by-products. This may compensate to a considerable extent for the disadvantages under which the industry will otherwise be. Unfortunately the lead-chamber acid plants throughout the country were completely dismantled by the Germans, and some time must elapse before they can be rebuilt.

Aside from commercial considerations the present physical condition of the plants will tend to retard the resumption of operations. With the exception of the Coleman plant, the plants in Belgium connected with the zinc industry were outside of the fighting area. This, however, did not prevent a large amount of physical destruction.

MUCH PROPERTY DESTROYED AND EQUIPMENT REMOVED

During the last two years of the occupation, the idle plants suffered largely from lack of maintenance and from equipment of all kinds removed. To obtain lead, the towers and chambers of the sulphuric acid plants were dismantled. This, of course, prevents an early resumption of roasting. Much property was destroyed to get cast iron, copper, and steel scrap. Rolling stock, machinery, belting and practically all of the copper transmission lines were removed from all of the plants. Naturally there was some distinction made in the character of material removed from the plants that were German owned and those owned by the Belgians. The former operated to a limited extent during the entire period of occupation and are in fair shape to resume work on an extensive scale.

The plant of the Dumont Frères on the Meuse River at Sielles, consisting of a roasting and acid plant, a spelter plant, a cinder concentrating plant, six lead furnaces and a refining plant for refining base bullion, was seriously damaged. Some of the buildings were left, but the metallurgical equipment was completely destroyed or removed. Other plants were damaged to a limited extent only, and most of the damage consisted of the removal of equipment and materials that could ordinarily—with the exception of lead chambers—be replaced within a comparatively short time. Of course the furnaces will have to be relined and many will have to be rebuilt on account of remaining idle for such a length of time.

The ore stocks were generally removed to the German plants in Belgium. Serious attempts were made to keep these running in part; nevertheless, even these suffered very considerably from careless operation.

To summarize briefly the situation, the smelting practice in Belgium has been developed along the lines of treating the ores so as to extract the greatest amount of metal values and to produce products that are most readily salable; thus large quantities of sheet zinc and zinc oxide have been produced.

Most attention has been given to transportation, quantities of raw materials used and maintenance of plants. While working conditions have not been neglected where they would affect the recoveries, the labor involved in the operations has not been considered to the extent common in this country, and the result is that the man-days per ton of ore treated are considerably in excess of those employed in this country. To this particular point attention will now have to be directed. Even before the war, it was becoming evident that further reductions in smelting cost must be made, and the Belgian engineers were turning their attention to this problem in regard to the labor required for roasting and also for furnace operations.

The Belgian engineers have contributed largely to the metallurgy of zinc, and while they are now handicapped in so many ways, it is entirely within the realm of possibility that they can meet the situation and restore the industry to a fair percentage of what it was before the war.

The longer this restoration is delayed the more difficult the problem becomes. The extent to which the smelting of zinc ore will be restored in Belgium is largely a matter of the time that it takes to get any of the operations under way.

The Electric Furnace Laboratory of the Bureau of Mines*

BY CHARLES D. GRIER

Assistant Metallurgist, Bureau of Mines

THE installation of transformer and switchboard equipment for electric-furnace work at the Seattle Station of the United States Bureau of Mines has recently been completed. The equipment is owned jointly by the Bureau of Mines and the University of Washington, and the electric-furnace laboratory, in which it is installed, is situated in the building of the College of Mines. Inasmuch as the design is novel in some respects, the following description may be of interest.

The function which the apparatus has to fulfill is the furnishing of power to experimental furnaces which will be built as required to meet the needs of the various problems as they present themselves. The exigencies of experimental work will make it necessary to build, tear down, and rebuild the furnaces until the proper solution has been reached. In order to allow the greatest freedom in designing these furnaces, the switchboard and transformer equipment was specified to furnish either single or two-phase power at voltages between 35 and 480. The variation of voltage was to be obtained in such a way that there would be no break of more than three volts within the range specified. Between 55 and 480 volts a capacity of 200 kilovolt-amperes was required as a minimum, but reduced capacity was permitted at lower voltages.

chanically couple the units together. The switchboard has three panels; one for the high-tension switches and protective devices, one for the low-tension switches and regulating devices, and one for the various meters. The bus bar system consists of two sets of ten 3-in. by $\frac{1}{2}$ -in. bus bars, supported on a pipe work frame, and inclosed in expanded metal grille-work, extending from the switchboard into the furnace room for a distance of 20 feet.

The primary windings of both the transformers and the regulators are connected to the 2500-volt, two-phase, four-wire system of the Seattle municipal power and lighting plant. The secondary winding of each of the transformers is divided into four coils, each capable of delivering 450 amp. at a voltage of 78. Connected in series with each coil is a secondary coil of one of the regulators, of equal carrying capacity, and capable of "boosting" or "bucking" a maximum of 43 volts.

The variation in voltage is obtained by changing the connections between the secondary coils, and by means of varying the amount of "boost" or "buck" of the regulators.

The single-phase induction voltage regulator is essentially a transformer in which the secondary winding is movable so as to intercept varying amounts of the magnetic flux generated by the primary winding. The induced secondary voltage is a maximum when the axes of the coils coincide (when the maximum flux is intercepted); zero when the coils are at right angles (when no flux is intercepted); and again a maximum, but in the opposite direction, when the axes of the coils coincide after the secondary coil has

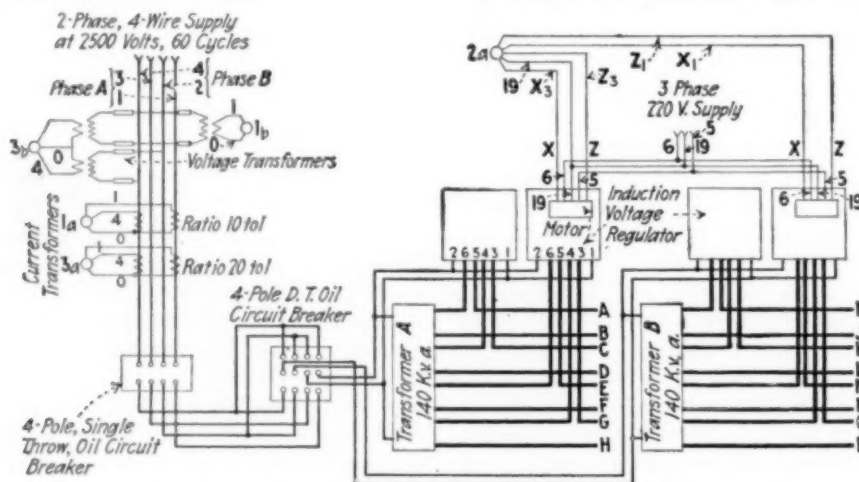


FIG. 1. WIRING DIAGRAM FOR TRANSFORMERS AND REGULATORS

The equipment was furnished and installed by the Westinghouse Electric & Manufacturing Co. It includes two transformers, two duplex induction voltage regulators, a three-panel, black marine slate switchboard, and a bus bar system for carrying the current from the switchboard to the furnace room.

The transformers are single-phase, oil insulated, self-cooled and rated at 140 k.v.a. at 40 deg. temperature rise for use on a 2500-volt, 60-cycle, primary circuit. The duplex regulators each consist of two Frame 12B 2500-volt, 60-cycle, motor-operated regulator units with a 220-volt, three-phase operating motor and the necessary shafting and gears to me-

been revolved 180 deg. from the first position. The induced voltage in the secondary therefore adds to or subtracts from the voltage of any feeder line with which it may be in series by a value varying from the maximum to zero, according to the relative position of the coils. Each transformer and regulator may, therefore, be considered as a variable voltage transformer with four secondary coils whose voltage varies between 35 volts (78 - 43) and 121 volts (78 + 43). The regulators are operated by motors controlled by push switches on the switchboard, so that by pushing one button on the board the voltage can gradually be raised, and by pushing another the voltage can be lowered.

The 2500-volt supply wires after passing the in-

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strument transformers and the main service switch are led to a 4-pole, double-throw oil switch. This is so connected that when the switch is thrown in one direction (see Fig. 1) both transformers (and their regulators) are connected in multiple to one phase. When the switch is in the other position one transformer and its regulator are connected to one phase and the other transformer and regulator to the other.

The four coils of each transformer and its corresponding regulator coils are connected to knife switches on the switchboard. These are in two sets,

which the regulators are "boosting" their maximum, i.e., at 121, 242, 484 volts. Many types of commercial furnaces require less than this maximum amount of power, and semi-commercial sizes of all types come within the capacity of this installation.

The instruments include an ammeter for each phase, a low-tension and high-tension voltmeter with the receptacles and plugs for reading the voltages on either phase, a two-phase power factor meter, a graphic wattmeter, and an indicating wattmeter. The watt-hour meters supplied by the city lighting de-

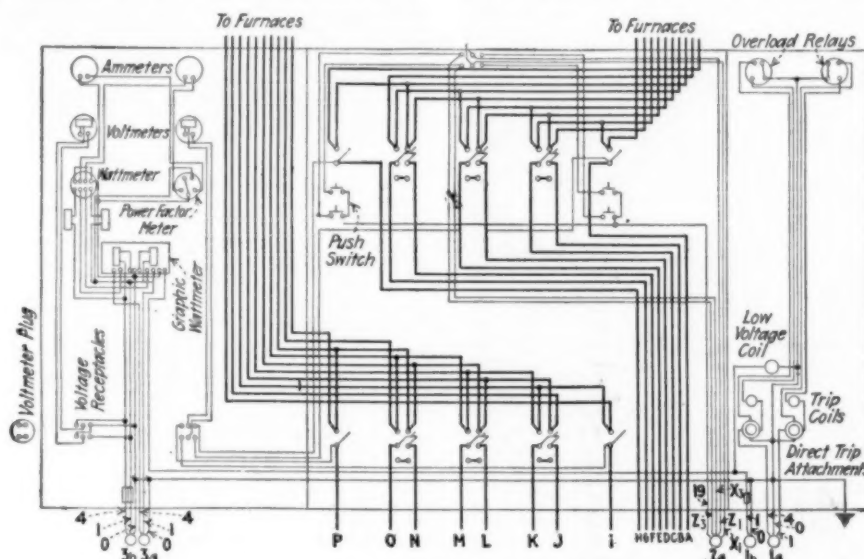


FIG. 2. WIRING DIAGRAM FOR SWITCHBOARD.

the upper set of two single-pole and three double-pole switches being connected to transformer A and feeding the upper set of bus bars, the lower set feeding the lower bus bar. The switches are so arranged that coils of the transformer-regulator combinations may be connected either all in series or in multiple or in two multiple series of two each.

For example, referring to Fig. 2, if the single-throw switches on transformer leads *P* and *I* are closed, and if the three double-throw switches between them are closed to the top, the four transformer coils are in multiple and every bus of the ten served by the transformer is of opposite polarity to its neighboring buses. If the single-throw switches are closed and the double switches are thrown down, the transformer coils are in series with alternate polarity with buses as before. Finally if the single-throw switches are closed, and the double-throw switches on leads *O*, *N*, *K* and *J* are thrown down but that on leads *M* and *L* thrown up, the coils between *M* and *N*, and *P* and *O* are in series with each other, but in multiple with the similar series combination of coils between *L* and *K*, and *J* and *I*. The amount of current that may be delivered, either all on one phase or equally distributed between two phases, is thus 3600 amp. at any voltage between 35 and 121, all the coils being in multiple; 1800 amp. between 121 and 242 volts when the coils are in multiple series; or 900 volts between 242 and 484 volts, when the coils would be in series.

The actual power capacity of the installation varies with the voltage and ranges from 126 kilovolt-amperes when the regulators are "bucking" their maximum amounts to 436 kilovolt-amperes at voltages at

partment, which are not shown in Fig. 2, are also mounted on the switchboard.

The bus bars are carried on pipe frames and are surrounded with expanded metal grille-work to prevent accidental contact with them. The sections of

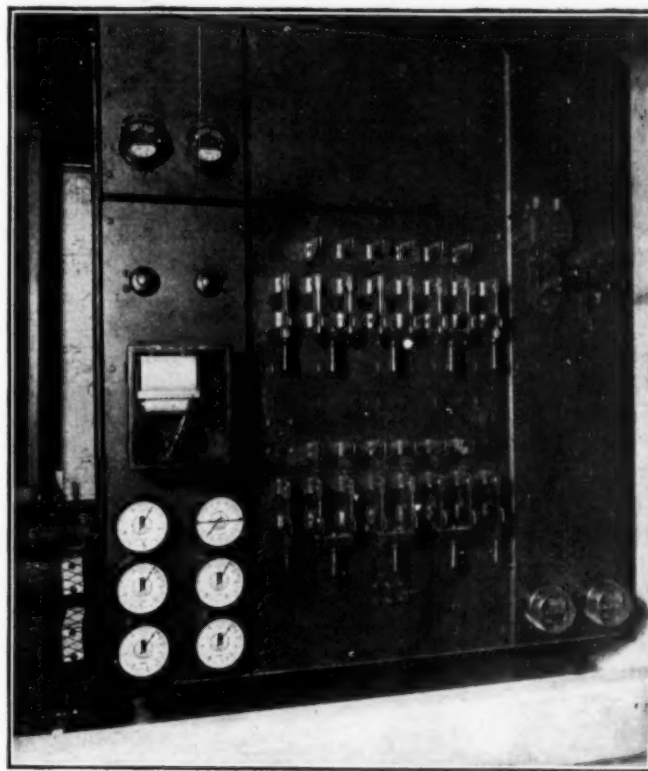


FIG. 3. SWITCHBOARD

this grille-work may be removed and suitable connections made to the bus bars in accordance with the requirements of the particular furnace being supplied with power. The buses are closely spaced; this and the alternation of polarity reduce the reactance to a minimum.

Among the accessory apparatus are a Leeds Northrup optical pyrometer, and a Beighlee three-station, recording pyrometer system. The recording instrument of the latter is mounted on a bench conveniently adjacent to the switchboard. Stocks of electrodes, refractories, electrode holders, cables and similar requisites are on hand to provide the materials for the erection or modification of furnaces.

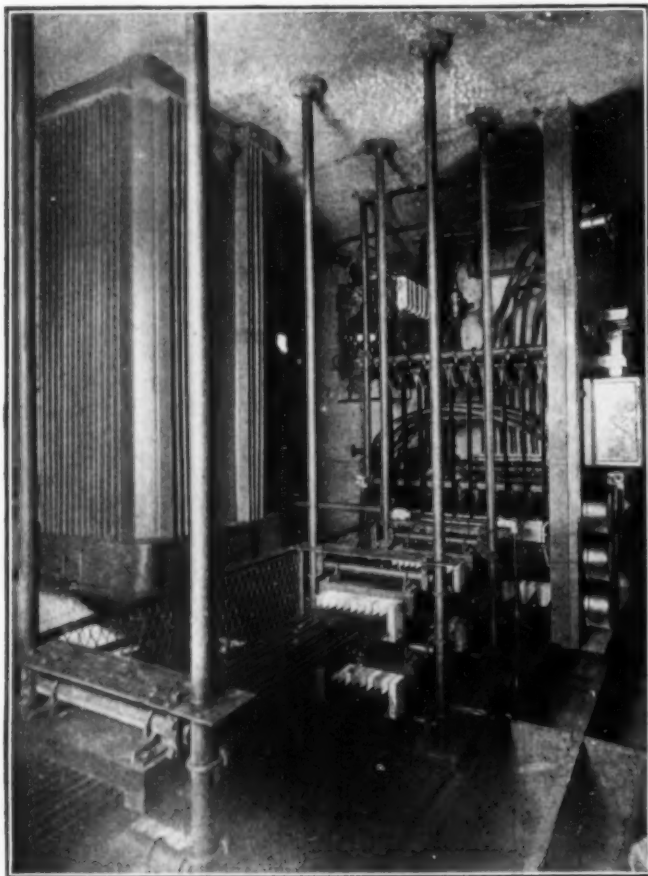


FIG. 4. REAR OF SWITCHBOARD.

The requirements of a source of energy for experimental electric furnaces are that it must be flexible, easily controlled, and capable of delivering ample power. The range in voltage possible in this installation is such as to give extreme flexibility. Merely pressing push buttons on the switchboard provides for voltage variation within wide limits; simpler control can hardly be imagined. Finally, the capacity is such as to provide for furnaces ranging in size from the smallest to that of commercial or semi-commercial ones.

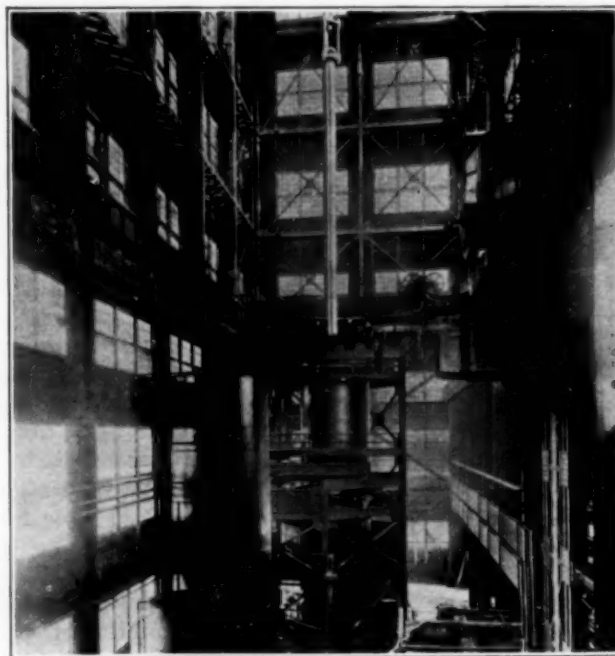
In this case, as in others, the customary policy of the Bureau will be followed, which permits, under suitable co-operative agreements, the use of its equipment by outside interests, when so doing does not result to the detriment of its own investigations. In this way there is made available, for those not having suitable facilities of their own, a group of apparatus which is believed to be remarkably adaptable

Allis-Chalmers Forge Shop

ABOUT twelve years ago the Allis-Chalmers Manufacturing Co. of Milwaukee, in the development of its large units for steam, electric and hydraulic plants, was face to face with the necessity of either going to the large forging plants in the East (or even to Krupps) for the large forgings required, which would necessitate delay and inconvenience as well as interfering very materially with deliveries; or spending a large sum of money and putting in a forge plant large enough to take care of this heavy forge work. The management decided on the latter course, immediately planning a new forge shop and designing it to take care of some future expansion by installing a 3000-ton hydraulic press of the steam intensifier type. Later a 1000-ton press and a series of various sized hammers were added. This gave the company more capacity than it required for its own needs, as it went into the market to sell heavy forgings, either rough forged, rough machined or finish machined.

On the 3000-ton press, forgings can be made up to 40 tons weight. This means that an ingot must be used weighing 55 to 60 tons, for the reason that the upper 20 to 30 per cent of the ingot must be discarded on account of being piped due to shrinkage in cooling. Within this weight shafts up to 60 ft. long or up to 48 in. diameter can be forged, heat treated and machined.

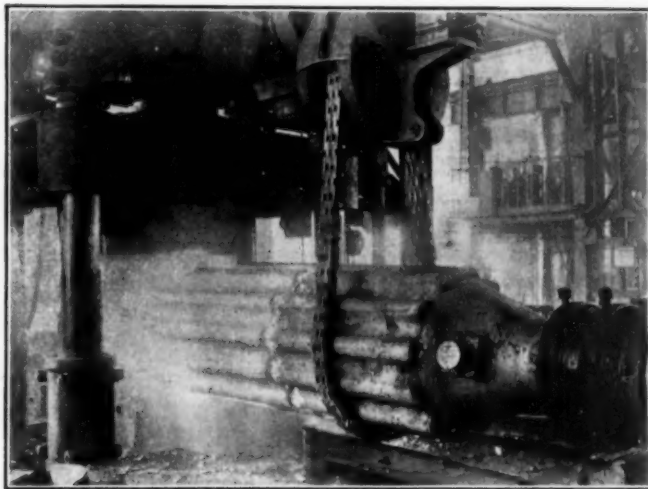
To satisfy the requirements of the engineering departments it was necessary to build a heat-treating plant. In this plant are 3 car type box furnaces 8 x 12 x 16 ft., 2 car type furnaces 6 x 8 x 30 ft., 2 car type furnaces 6 x 8 x 45 ft., 1 car type furnace 6 x 8 x 50 ft., 1 open top furnace 5 x 7 x 16 ft., and 1 open top furnace 6 x 8 x 50 ft., and many others of smaller dimensions. All of these horizontal furnaces are of the semi-muffle car type. For the heat treatment of the hollow shafts, two large semi-muffle vertical furnaces are provided, one being 14 ft. diameter by 70 ft.



INTERIOR OF HEAT-TREATING PLANT, SHOWING LARGE VERTICAL FURNACES AND QUENCHING TANKS



ROUGH FORGING FOR NO. 27 GYRATORY CRUSHER SPINDLE



HOT INGOT BETWEEN ANVILS OF 3000-TON HYDRAULIC PRESS

high, for treating shafts up to 60 ft. long, the other being the same diameter and 50 ft. high.

There are also horizontal and vertical quenching tanks in which the largest forgings can be handled, the largest vertical tank being 14 ft. diameter by 75 ft. deep.

A large stock of billets and ingots are carried in stock, billets up to 24 in. x 24 in. x 12 ft. long and ingots from 14 in. diameter up to 62 in. diameter weighing 60 tons. These are of low, medium and high carbon, nickel steel, vanadium steel, chrome-vanadium, and chrome-nickel steel. The alloy steels are carried in different analyses, and may be oil tempered or heat treated to meet a wide variety of requirements.

Heating furnaces are all equipped with the latest type Leeds & Northrup recording pyrometers and arranged to get temperature readings every few feet on the length of the forging from either side or from the top every few minutes. The indicators are installed in a central pyrometer room, where the temperature is continually under observation by expert metallurgists.

This line of work has developed side by side with the forging development until the Allis-Chalmers Manufacturing Co. now has one of the most complete plants in the country and is in a position to meet the most stringent requirements of U. S. Navy, Army,

Ordnance Departments, American Bureau of Shipping, Lloyds Survey and American Society of Testing Materials.

When war broke out the company was in splendid shape to take on work for the U. S. Government and the Emergency Fleet, and therefore took on some very large orders which kept it busy twenty-four hours per day until the armistice was signed.

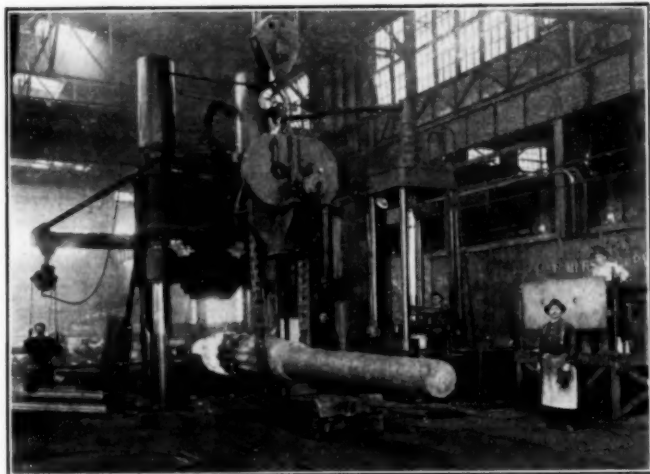
In the list of forgings made by the company during the war period appear guns, and tubes, torpedo cylinders, recoil cylinders and pistons for largest Navy guns; shafting for battleships, cruisers and destroyers; shafting, connecting rods, rudder stocks, etc., for the Emergency Fleet.

Government Disposes of TNT

Disposition has been made of the 29,000,000 lb. of TNT which was declared surplus shortly after the signing of the armistice. At that time the War Department expressed the opinion that the surplus was so great that a portion of it had best be dumped into the ocean. The Bureau of Mines, however, suggested at that time that it would be possible to utilize the explosive in road and reclamation work in which the Government is interested. This resulted in legislation turning over the TNT to that bureau. That all of it should be allotted within 11 months after the armistice, however, came as a surprise even to the Bureau of Mines officials.

Of the 14,000,000 lb. actually distributed, 9,000,000 has gone to the Bureau of Public Roads, for use on Federal aid projects; 2,000,000 has been turned over to the Forest Service, for road work on the reserves under its jurisdiction, and the remainder has been used by the Reclamation Service, the National Park Service and the Indian Office.

While under ordinary conditions it is regarded as improbable that TNT could compete commercially with dynamite, a great saving to the people has been made by the use of this surplus explosive. In road work contractors have allowed from 20 to 25c. per cu.yd. of the material to be removed by blasting. While that amount does not represent the full value of the explosive, it is considerably in excess of the 12½c. per lb. offer made for a portion of the surplus.



1000-TON HYDRAULIC PRESS

Synopsis of Recent Chemical and Metallurgical Literature

Acetic Acid and Acetone From Calcium Carbide.—

The August, 1919, issue of the *Canadian Chemical Journal* is devoted to the chemical and electrochemical industries of Shawinigan Falls, Quebec. Possibly the most interesting chemical development at Shawinigan and one of the notable achievements in the chemical world during the period of the war has been the manufacture of acetic oxide and acetone from calcium carbide.¹

Experimental work was started in December, 1915, a plant (covering 15 acres) was completed in January, 1917, and the first car of acetone was shipped to the British War Ministry early in January.

The process may be divided into five stages:

1. Production of acetylene from calcium carbide.
2. Production of mercuric acid from metallic mercury.
3. Production of acetaldehyde from acetylene.
4. Oxidation of acetaldehyde to acetic acid.
5. Conversion of acetic acid into acetone.

The production of acetylene had previously been carried out only on a small scale, involving the generation of a few hundred cubic feet per day for town lighting. The process at hand called for 500,000 to 600,000 cu.ft. per day. After considerable experimentation, a generator was developed which was capable of handling half a ton of carbide at a single charge. By the end of 1916, a plant was constructed having a capacity of 600,000 cu.ft. per day. At present, the plant can deliver 1,200,000 cu.ft. of acetylene per day.

Mercuric oxide is the catalyst required in the conversion of acetylene into acetaldehyde. Since the cost of producing the oxide from the nitrate was prohibitive, an electrolytic oxidation method was developed. The cell consists of a cast-iron pot, 6 ft. in diameter, 15 in. high, with a stirrer sweeping the surface of the mercury (which forms the anode) to remove the oxide as formed. The electrolyte employed is caustic soda solution and the mercuric oxide is removed in suspension in the electrolyte. The oxide is allowed to settle in tanks and is used in a wet condition.

In the next step, which consists of passing acetylene gas into dilute sulphuric acid solution in which mercuric oxide is held in suspension by vigorous stirring, the most difficult problem was to find an engineering material which would withstand the action of the acid and at the same time resist the amalgamating action of the mercury. A special silicon iron of sufficient mechanical strength was developed for this purpose. By the use of a large excess of acetylene, the aldehyde is removed continuously. During the process, the mercuric oxide is reduced to a fine sludge containing mercuric organic compounds. The recovery of the mercury from this sludge was a difficult problem because of the nature and poisonous character of the material.

For the oxidation of acetaldehyde to acetic acid, a process was developed, using air (it was found im-

possible to secure Claude or Linde compressors to furnish oxygen) and a specially designed aluminum-lined conversion kettle. Copper, iron, etc., were found to act as surface catalysts, causing violent explosions. The acetic acid obtained is about 98 per cent pure and yields glacial acetic acid by a single distillation. About 30 tons of nitrogen is obtained every day as a by-product. No use is made of this at present.

The catalyst finally selected for the last operation—the conversion of acetic acid into acetone—was hydrated lime containing a small amount of magnesia. The conversion chamber was a steel tube, 13 ft. long and 12 in. diameter, electrically heated by means of resistance ribbons, and filled with rough cast-iron balls coated with a paste of the catalyst. Seventy-two of these tubes were installed for the production of ten tons of acetone per day. The temperature employed was 485 deg. C. and the average efficiency over a period of months was 85 per cent. The mixture of acetone, water vapor and unconverted acetic acid was passed through scrubbers containing soda-ash solution, maintained at 98 deg. C. by the heat from the gases. This removed the acetic acid vapors, while the acetone and water vapor passed to the condensers, where a 20 per cent aqueous solution of acetone was obtained, which was rectified in a regular continuous acetone still.

Graphical Representation of the Composition and Properties of Fuels.—In the *Technische Rundschau*, Berlin, for Aug. 6, 1919, Dr. K. SCHREBER treats graphically of the composition and properties of fuels. The latest investigations have shown that our fuels never contain pure carbon, even those richest in carbon, but always consist of hydrocarbons which are poor or rich in carbon. No one has yet succeeded in separating these hydrocarbons from each other, and we can only, at present, regard the fuels as homogeneous substances, and investigate their composition *en masse*.

It has been found advisable to consider the real fuel as consisting of carbon, hydrogen and oxygen, leaving out the ash and the moisture evaporated at about 100 deg. C., considering them as accidental or non-essential constituents. The percentage composition of the real or pure fuel is thus calculated, and since there are only three essential constituents it can be graphically placed on a triangular diagram such as is used in chemical and metallurgical investigations. Since the properties of the fuel are dependent on the proportions of these three fundamental elements, fuels of like properties should come in the same regions of the diagram.

When such a calculation and diagram is made for the common fuels, it is found that they do not group themselves satisfactorily according to properties. The tar oils and the petroleum oils, for instance, come close together on the diagram, although they have very different properties, and the same is true of other fuels; in other words, placing on the diagram according to percentage composition by weight does not lead to satisfactory differentiation of the various fuels.

However, modern chemistry is teaching us that the properties of compound substances are dependent primarily upon the relative number of the atoms of the different elements entering into their composition. These relative numbers of the constituent atoms can be easily obtained by dividing the percentage of each

¹"The Work of the Canadian Electro Products Company in the Synthetic Production of Acetic Acid and Acetone From Calcium Carbide," H. W. Matheson, *Canadian Chemical Journal*, August, 1919, p. 258.

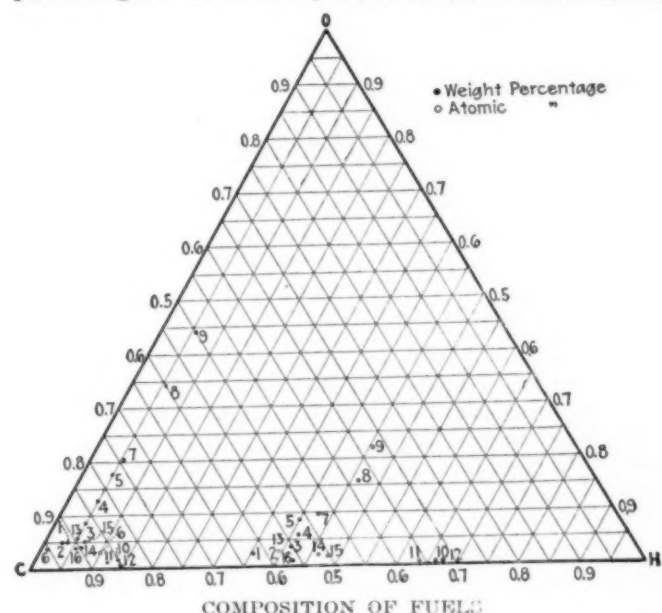
element by the atomic weight of that element. For example, if a pure fuel contains 91.5 per cent carbon, 4.3 per cent hydrogen and 4.2 per cent oxygen, and the relative atomic weights of these three elements are 12, 1 and 16, respectively, then the quotients indicated will represent the relative numbers of the atoms of these elements present in the fuel. These relative numbers can be transformed into parts in 100, which are then called the *atomic* percentage composition. The arithmetical calculation is as follows:

Gravimetric Percentage	÷	Atomic Weights	=	Atomic Composition
C 91.5 per cent	÷	12	=	7.53 = 62.6 per cent
H 4.3 per cent	÷	1	=	4.30 = 35.3 per cent
O 4.2 per cent	÷	16	=	0.26 = 2.1 per cent
				12.09 100.0

In the following table, the characteristic composition of 16 typical pure fuels is given, first in percentage by weight and next in atomic percentages; the last column gives the ratio of number of atoms of hydrogen to those of carbon.

No. on Chart	Fuel	Weight Percentage	Atomic Percentage	At. H/At. C.
		C H O	C H O	
1	Anthracite	91.5 4.3 4.2	62.6 35.3 2.1	0.564
2	Short-flame bit	89.5 5.0 5.5	58.3 39.0 2.7	0.670
3	Blacksmith coal	86.5 5.3 8.2	55.4 40.7 3.9	0.733
4	Long-flame bit	82.5 5.4 12.1	52.8 41.4 5.8	0.784
5	Non-coking bit	77.5 5.0 17.5	51.5 39.8 8.7	0.773
6	Coke	95.2 0.9 3.9	87.4 10.0 2.6	0.115
7	Brown coal	74.1 5.6 20.3	47.4 42.9 9.7	0.905
8	Turf, peat	59.9 6.1 34.0	37.6 46.2 16.2	1.230
9	Wood	50.0 6.0 44.0	32.3 46.4 21.3	1.437
10	Penna. crude petroleum	84.9 13.7 1.4	33.9 65.7 0.4	1.938
11	Russian crude petroleum	86.6 12.3 1.1	36.8 62.8 0.4	1.708
12	Kerosene	85.3 14.2 0.5	33.3 66.6 0.1	2.000
13	Inclined coke-tar oven	89.4 5.0 5.6	58.2 39.1 2.7	0.672
14	Vertical coke-tar oven	89.5 6.6 3.9	52.2 46.1 1.7	0.883
15	Retort coke-tar oven	88.2 6.9 4.9	50.5 47.4 2.1	0.930
16	Retort coke-tar oven	90.8 5.6 3.6	56.5 41.8 1.7	0.740

On the accompanying tri-axial diagram, the solid points represent the position of the weight percentages, while the small circles represent the atomic percentages. It is easily seen that the latter gains



a much better distribution into groups than the former, bringing together into the same locality on the diagram the fuels of similar properties. The atomic hydrogen percentage, in particular, seems to regulate the distribution into groups which correspond to similar behavior during combustion. The nearly flameless coals congregate around the carbon corner, while those with short or long flames pass toward the hydrogen corner the longer their name.

Recent Chemical and Metallurgical Patents

British Patents

Complete specifications of any British patents may be obtained by remitting 25c. each to the Superintendent British Patent office, Southampton Buildings, Chancery Lane, London, England.

Vegetable Charcoal.—Vegetable charcoal for filtering, deodorizing or decolorizing purposes is prepared by mixing pine and like needles with from 1 to 5 per cent of lime or soda-lime, carbonizing at a bright red heat, treating with dilute hydrochloric acid, and finally washing with water or with a dilute alkaline solution. The lime may be replaced by somewhat more than an equivalent amount of calcium carbonate. (British Patent 122,465—1918. G. PENROSE, 85 Brondesbury Villas, Maida Vale, London, and J. D. PENROSE, Oxhley Grange, Watford. March 26, 1919.)

Dimethyl Sulphate.—Dimethyl sulphate is prepared by the reaction of sulphur trioxide on dimethyl ether in the presence of a solvent or diluent, preferably dimethyl sulphate itself. The sulphur trioxide used is preferably diluted with an indifferent gas; thus a current of air may be passed through hot fuming sulphuric acid and the resulting mixture of air and sulphur trioxide used, or the mixture of air, sulphur dioxide and sulphur trioxide resulting from the contact process of making sulphur trioxide may be used. The product of the reaction is treated either with ice or preferably with a reducing agent such as iron filings to destroy any sulphur trioxide present and is purified by distillation in vacuo. (British Patent 122,498—1918. W. N. HAWORTH and J. C. IRVINE, University St. Andrews, Fifeshire. March 26, 1919.)

Parchmentized Paper.—Paper is parchmentized and rendered waterproof, acid proof and of great strength by passing it through two baths of sulphuric acid or sulphuric acid mixed with sulphurous acid, the second being more dilute than the first, the acid being squeezed out after each operation, the paper being afterward neutralized by means of an alkali bath, washed, softened by means of a bath of glycerine, calcium chloride, salt or the like with or without admixed loading material and then dried. (British Patent 123,594—1918. W. DAGNALL, 26 Sandy Lane, Hampton Wick, Middlesex. April 26, 1919.)

Synthetic Preparation of Ammonia and Cyanogen Compounds.—The synthesis of ammonia, ammonium cyanide, and hydrocyanic acid by means of the action of electric arcs, sparks, or silent discharges on mixtures such as nitrogen and hydrogen; nitrogen and hydrocarbons; nitrogen, carbon monoxide, and hydrogen; nitrogen and water gas; producer gas and hydrogen; and illuminating gas and hydrogen, is effected under a pressure less than 200 mm. of mercury. An excess of nitrogen may be employed, and when carbon compounds are used hydrogen may be added to avoid the production of soot. The electrodes and armatures may be cooled, and the gases may be cooled immediately after the electrical treatment. (British Patent 123,760—1918. GROS & BOUCHARDY, 39 rue Camton, Paris assignees of E. BRINER and A. BAERFUSS, Geneva, Switzerland. April 30, 1919.)

Recovering Brass.—Brass is recovered from foundry ash and the like remaining in the crucibles, etc., after the brass has been poured therefrom, by heating the ash to 1050-1250 deg. C. and stirring or kneading the mass so long as the molten brass continues to collect. A flux such as borax, glass, or soda ash may be used, and copper may be recovered from the resulting slag electrolytically. A reducing agent such as charcoal or carbon copper may be mixed with the ash. (British Patent 124,019—1918. C. H. WHITE, Park Road, Coventry. May 7, 1919.)

Dissolving Cellulose.—Solutions or viscous or gelatinous masses are obtained by treating cotton or other cellulose with solutions of thiocyanates, such as those of calcium, manganese, strontium or lithium. Thiocyanates which are insoluble or sparingly soluble, such as mercury thiocyanate, may be used in conjunction with those which are more soluble, such as sodium thiocyanate. Salts such as calcium chloride, or salts which dissolve cellulose, or acids such as acetic, may be added to the solution. (British Patent 123,784—1918. MANCHESTER OXIDE CO. and R. H. CLAYTON, Canal St., Miles Platting, Manchester; J. HUEBNER, Linden, Cheadle Hulme, Cheshire, and H. E. WILLIAMS, 19 Chattam Road, Withington, Manchester. April 30, 1919.)

American Patents

Complete specifications of any United States patents may be obtained by remitting 10c. each to the Commissioner of Patents, Washington, D. C.

Electric Furnace.—IVAR RENNERFELT, of Djursholm, Sweden, improves the construction and design of an electric-arc-furnace for melting metals, glass, enamels and other materials in crucibles. The furnace is illustrated in Figs. 1 and 2. Fig. 1 is a vertical section taken at lines *y-y* in Fig. 2, which is a horizontal section taken at the lines *x-x* in Fig. 1. The vertical electrode (1) extends through the roof, making

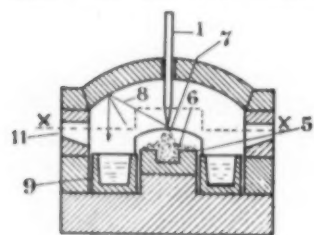


Fig. 1.

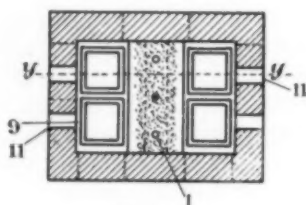
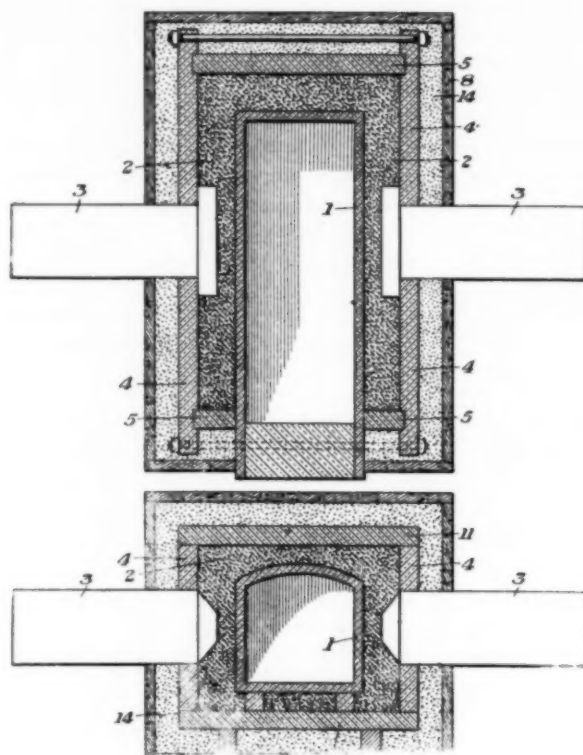


Fig. 2.

an arc (7) with the granular carbon or graphite (6) contained in the carbon block (5). The crucibles (9) are heated by radiation from the arc and by reverberation from the roof as shown at (8). Openings (11) are provided for the insertion of implements. (1,313,834; Aug. 19, 1919.)

Electric Furnace.—JOHN FITZPATRICK and L. T. STEVENS of Niagara Falls, N. Y., produce an efficient muffle type of resistance furnace which is illustrated. The muffle (1) is composed of silicon carbide without bonding material, the walls being about $\frac{1}{2}$ in. in thickness. The resistance mass (2) of granular carbonaceous material surrounds the muffle on all sides but one, electrical contact being made through the graphite electrodes (3). The resistance mass is retained by slabs of silicon carbide (4), (5), (10) and (11). The outside casing is composed of asbestos board or similar



ELECTRIC FURNACE—ABOVE, HORIZONTAL CROSS-SECTION, AND BELOW, VERTICAL CROSS-SECTION

material and the space (14) is packed with heat insulating materials. In operating a small furnace of this type, measuring 6 x 6 x 18 in. with the layer of resistance material 1 in. in thickness around the muffle, a temperature of 1500 deg. C. was attained with a power consumption of 9 kw. at 20 volts. This design of resistance furnace permits of close regulation, the atmosphere being neutral or reducing. (1,313,985, Aug. 26, 1919; assigned to the Carborundum Co.)

Progress in Tanning Fish Leather

Excellent progress in the tanning of fish leather is to be recorded, and a number of the difficulties obstructive to the development of the industry have been overcome by tanners in this field.

One company which is tanning fish skins has established a station in North Carolina and another in Florida for the capture of sharks and porpoises, and is meeting with success in its fishery for sharks. It is understood that the number of stations will be increased as rapidly as possible. Another company has recently acquired a site for a tannery in Washington which plans to tan the hides of sharks, beluga, hair seals, etc.

Samples of leather recently submitted show marked improvement in appearance over earlier samples. The leather is soft and pliable and appears to have ample strength for many uses. Arrangements have been perfected for the Bureau of Standards to make tests of the leather products as to durability, porosity, tensile strength, pliability, water absorption, wearing qualities, etc.

The nets which the Bureau developed for the capture of sharks are proving successful and are being adopted for the fishery. At the fishery stations the liver oil is being extracted and the flesh converted into fertilizer, so that none of the material is wasted.

Refined Potassium Salts in 1918

The statistics of the domestic production of refined potassium salts in 1918 compiled by the United States Geological Survey, Department of the Interior, are now practically complete, and they represent the first attempt at such compilation. The figures are classified in greater detail than heretofore and, except those for a few items and some minor chemicals, are believed to be substantially correct. About 30 different refined potassium salts were produced by 47 firms in 1918. The total production amounted to 53,503,017 lb., valued at \$17,491,414, and the sales amounted to 43,674,844 lb., valued at \$15,634,125. In addition there were produced 62,972,000 lb. of potassium chloride, more or less refined, valued at \$5,749,216, and 13,652,000 lb. of potassium sulphate, valued at \$1,530,499. These two salts were derived from original sources and were used in fertilizers or as raw materials in the production of other refined potassium salts. Table I, compiled by W. B. Hicks, of the Survey, summarizes the production

TABLE I.

Production and sale of refined potassium salts in the United States in 1918(a)

	Number of Firms	Production		Sale	
		Lb.	Value	Lb.	Value
Acetate.....	5	93,307	\$60,761	90,229	\$59,314
Aluminum sulphate (alum)b.	3	10,922,955	275,041	9,699,645	251,181
Bromate, iodate, and perchlorate.....	3	513,100	245,611	510,699	243,198
Bromide.....	3	666,119	593,079	616,232	551,079
Carbonate and bicarbonate c.....	4	229,287	115,504	201,574	104,432
Chlorate.....	3	9,753,424	2,837,892	9,752,424	2,837,892
Citrate.....	6	99,193	144,544	96,273	141,517
Chromate and bichromate.....	4	681,346	280,298	1,003,598	407,793
Ferrocyanide.....	3	457,267	304,666	306,535	204,190
Hydroxide (caustic).....	14	1,984,847	1,033,943	1,594,580	856,148
Iodide.....	8	521,678	1,722,570	481,301	1,587,656
Nitrate.....	4	16,250,433	3,568,569	8,176,382	2,206,788
Permanganate.....	9	562,416	971,728	530,837	922,746
Tartrates d.....	5	10,869,874	5,672,849	10,717,674	5,596,732
All others e.....	3	56,430	63,114	54,520	62,214
		53,661,676	\$17,576,876	43,833,503	\$16,032,880

a Potassium chloride, potassium sulphate, and other products derived from original sources not included.

b Includes both the hydrous (potash alum) and the anhydrous (burnt alum) salt.

c In addition 1,827,000 lb. of crude carbonate from wood ashes, valued at \$350,445, was produced, and 1,753,000 lb., valued at \$331,000, was sold.

d Includes neutral, acid (cream of tartar), sodium (Rochelle salt), and antimony (tartar emetic) tartrates.

e Includes bisulphate, bisulphite, ferricyanide, oxalate, phosphate, sulphide and sulphite.

TABLE II.

Potassium salts imported and entered for consumption in the United States in 1918

Refined Salts

	Quantity, Short Tons	Value
Bicarbonate.....	36	\$34,279
Bitartrate.....	7	3,355
Carbonate.....	104	65,974
Chlorate.....	355	248,160
Chromate and bichromate.....	a 20	8
Cyanide.....	12	10,278
Ferricyanide.....	8	29,201
Ferrocyanide.....	65	112,729
Iodide.....	32	142,324
Nitrate.....	2	730
Permanganate.....	27	128,438
Rochelle salt.....	8	4,948
	656	\$780,424

Crude Salts

Muriate.....	424	\$102,100
Sulphate.....	101	15,29
Bitartrate (argol).....	14,041	4,782,267
Carbonate, crude.....	4,297	2,273,202
Carbonate, crude black salts.....	228	47,956
Nitrate, crude.....	4,672	906,549

Total..... 24,419 \$8,907,836
aPounds

of all potassium salts except the two last named with as much detail as is consistent with the confidential nature of the individual reports.

The figures show that the production in 1918 was only about half that in 1914, when more than 80,000,000 lb. were produced, but the total value of the output in 1918 was about double that in 1914, for the average price per lb. in 1918 was about four times that in 1914.

EXPORTS

The exports of potassium salts in 1918 were valued at \$1,372,170 and included 696 short tons of potassium chlorate, valued at \$534,491. All other salts were valued at \$837,679. The value of the exports was nearly ten times that in 1914, which amounted to \$132,729. In 1914 muriate constituted the bulk of the exports; in 1918 chlorate made up a large part of them.

Acid-Proof Apron

While aprons made from rubber fabric have been fairly satisfactory in storage battery service stations and other places where the work was light, they have been a failure in acid-pickling works, where they received rough mechanical treatment. With all its inconveniences and cost, however, it has never appeared a sufficiently important matter to any individual manufacturer to devote the necessary amount of research to the proper solution of the problem, practically every concern being satisfied to get along the best it could with whatever kind of so-called rubber aprons they could pick up, and getting what service they could out of them.

The Defiance Welding Co., of Defiance, Ohio, manufacturing automotive equipment of various kinds, including the ordinary automobile wash apron, has been giving a considerable amount of thought and laboratory time to this question, and after repeated failures and near-successes has finally succeeded in producing the Invincible acid apron which, it is claimed, lives up in every way to its name, and which in fact was not given its present name until it had thoroughly proved its merits, not only in the Defiance Welding Co.'s factory, but also in numerous manufacturing plants throughout the country having the most severe acid conditions.

The special fabric which has been developed for use in this apron has an extremely high resistive quality to all acids, giving an unusually long life under the worst conditions, but the fabric is produced in such a way that it can be put on the market at a very reasonable price, comparing favorably with the ordinary rubber apron in price and lasting very much longer.

Obituary

DR. CYRIL G. HOPKINS, head of the department of agronomy at the University of Illinois, died at Gibraltar on Oct. 6, of malaria. He had finished one year's study of the exhausted soils of Greece and was returning home after completing his official report. He was 53 years of age. He was primarily a chemist and announced the doctrine that "the farmer should first know his soil by an inventory of its constituents, particularly those likely to run short, as a merchant takes frequent inventory of his stock and places timely orders where it is running short and leaving the full shelves alone until they, too, begin to run low." He, therefore, opposed the theory of mixed fertilizers just as he did that of a patent medicine, holding that a proper examination will indicate what is lacking. He also insisted that the farmer should put back into the soil what he took from it.

Personal

Dr. HAROLD S. ADAMS has been promoted to production manager for Squibbs & Sons, New Brunswick, N. J.

Dr. WILLIAM D. BONNER has returned to Salt Lake City after a summer at Rangely, Colo., where he was operating the Raven Oil & Refining Co.

Mr. LINN BRADLEY, formerly chief engineer for the Research Corporation, administering the Cottrell patents in certain industries, has resigned to engage in consulting practice at 46 South Arlington Ave., East Orange, N. J. He will specialize on apparatus and personal service for the collection of dust and fumes.

Dr. HORACE G. BYERS has accepted the chair of chemistry at Cooper Union, New York City.

Mr. CHARLES A. CHASE, mining and metallurgical engineer, Denver, Colo., recently spent a few days in New York City.

Dr. E. O. ELLINGSTON has accepted the chair of chemistry at St. Olaf's College, Northfield, Minn.

Mr. F. B. FOLEY has gone from the Pittsburgh laboratory of the Bureau of Mines to Dr. Howe's laboratory at Bedford Hills, N. Y., in connection with the co-operative investigation on carbon steels there in progress.

Dr. C. C. FOWLER has accepted the position of research chemist for the National Candy Co., Chicago, Ill.

Mr. WALTER H. GARASHA has accepted the managership of the Atlas Laboratory Equipment Bureau, 731 North Wells St., Chicago, Ill.

Mr. HERBERT W. GEPP, general manager of the Electrolytic Zinc Co., Hobart, Tasmania, has been visiting in New York City.

Sir RICHARD GLAZEBROOK has resigned the directorship of the National Physical Laboratory at Teddington, England, which he held since its organization in 1899.

Mr. CARL HELGESON has resigned his position as chemist with Swift & Co. to accept employment with the Liquid Carbonic Co., Chicago, Ill.

Dr. DAVID KLEIN, recently relieved from active duty as Major, U. S. Army, has returned from foreign service to assume the duties of a new position on the faculty of Johns Hopkins University. While serving in Europe he was instrumental in putting the French bakeries on a sanitary basis for the production of bread furnished to the A. E. F., and also held a diplomatic commission with the Herbert Hoover staff in Serbia.

Dr. S. C. LANGDON, department of chemistry, Northwestern University, has added the duties of chemist and bacteriologist of the city of Evanston to his university work. He succeeds Dr. W. LEE LEWIS, resigned.

Mr. E. R. LEDERER, formerly connected with the Galena Signal Oil Co. and more recently with the Home Oil Refining Co. of Texas, is now connected with the Atlantic Gulf Oil Corporation, 11 Broadway, New York.

Mr. G. M. MCCOLLOUGH has resigned as manager of the heavy acid sales department of the Monsanto Chemical Co. He is succeeded by A. B. BRADLEY, who has been with the company for some time.

Mr. A. G. MCGREGOR has returned to Warren, Ariz., after several days in New York City in connection with the work of rebuilding Cerro de Pasco.

Dr. E. P. MATHEWSON resigned his position Nov. 1 as director of the American Smelting & Refining Co. and the American Smelters Securities Co. and has opened an office at 42 Broadway, New York City, as consulting engineer.

Mr. J. H. NEAD, who during the war served as Captain in the Ordnance Department of the Army in this country and France, has become associated with the American Rolling Mill Co. as metallurgist.

Mr. H. C. PARMELEE addressed the Society of Industrial Engineers at Cleveland on Oct. 31, on "The Effect of European Conditions on American Industry."

Mr. J. H. PERRY, who was associated with Captain Curtis at U. S. N. P. No. 1, Sheffield, Ala., during the war, has returned to Northwestern University, Evanston, Ill., to continue his work with Dr. Curtis.

Dr. R. R. RENSHAW has been placed in charge of chemical engineering courses at the University of Minnesota, Minneapolis, Minn.

Mr. C. H. REPATH visited metallurgical plants in the vicinity of New York the latter part of October.

Mr. GILBERT RIGG, formerly of the New Jersey Zinc Co. and now metallurgist for the Associated Smelters Proprietary, Ltd., Melbourne, Australia, was in New York City recently.

Dr. JAMES K. SENIOR, having been relieved from active duty in the Chemical Warfare Service, has joined the research staff of Procter & Gamble, Cincinnati, Ohio.

Mr. ARTHUR VAN KLEEK has returned from foreign service with the Sanitary Corps, U. S. Army, to accept his old position as chemist with the Western Electric Co., Chicago. He was engaged in water purification work for the A. E. F.

Mr. WILLIAM WRAITH is in the Rocky Mountain region, inspecting properties of the International Smelting Co. and affiliated corporations.

Current Market Reports

The Non-Ferrous Metal Market

Monday, Dec. 1.—A sharp advance in the Eastern price of tin caused a firmer tone in shipments from the Straits for January-February delivery. In November, deliveries into consumption from Atlantic ports amounted to 5600 tons, with stocks and landing on Nov. 30 aggregating 5000 tons. Prime Western zinc is strong at 8.45c. in New York. Copper remains steady, though the feeling has recently improved. Large interests quote 18½c. a pound.

	Cents per Lb.
Aluminum, New York, 98-99% ingots.....	33.00
Antimony, New York, Chinese and Japanese.....	9.375
Copper, New York, spot.....	15.25
Lead, New York, spot.....	6.70
St. Louis, spot.....	6.62½
Tin, Straits, spot.....	54.37½
99 per cent, spot.....	53.50
Zinc, New York, spot.....	8.45
St. Louis, spot.....	8.12½

FINISHED AND SCRAP METALS

Copper sheets, hot-rolled.....	lb.	30.00	—
Copper sheets, cold rolled.....	lb.	35.00	—
Copper bottoms.....	lb.	38.00	—
Copper rods.....	lb.	27.00	—
Copper wire.....	lb.	28.25	—
High brass wire and sheets.....	lb.	25.25	—
High brass rods.....	lb.	23.75	—
Low brass wires and sheets.....	lb.	27.50	—
Low brass rods.....	lb.	28.25	—
Brazed brass tubing.....	lb.	37.50	—
Brazed bronze tubing.....	lb.	42.00	—
Seamless copper tubing.....	lb.	33.50	—
Seamless bronze tubing.....	lb.	35.50	—
Seamless brass tubing.....	lb.	32.50	—
Scrap, heavy machinery comp.....		14	— 14½
Scrap, heavy and wire.....		13½	— 14
Scrap, light and bottoms.....		12½	— 12½
Scrap, heavy, cut and crucible.....		15½	— 16
Scrap brass, heavy.....		7½	— 8½
Scrap brass, casting.....		10½	— 10½
Scrap brass, light.....		5½	— 6½
Scrap, No. 1 clean brass turnings.....		8½	— 8½
Scrap, No. 1 comp. turnings.....		11½	— 12

OTHER METALS

Bismuth.....	lb.	\$2.85	—
Cadmium.....	lb.	2.00	—
Magnesium.....	lb.	1.95	—
Mercury.....	75 lb.	85.00	—
Nickel.....	lb.	.42	— .45
Iridium.....	oz.	175.00	—
Platinum.....	oz.	130.00	— 135.00
Silver.....	oz.	1.295	—

The Iron and Steel Market

The iron and steel industry is now almost through with its strike and yet the excess of demand over supply, in the market, has increased. There are three reasons. First, stocks in the hands of buyers, both jobbers and manufacturing consumers, are quite largely exhausted. Early in the strike, which started ten weeks ago, they were drawn upon in such manner as to make up in great measure for the curtailment in production caused by the strike. Second, ending of the strike in a given plant or district

does not mean the immediate resumption of normal production, as production grows rather slowly, and the after effects of the strike may last for months, in decreasing intensity. Third, there is the psychological factor. The majority of buyers have become convinced that there is going to be a shortage of steel, hence they magnify their requirements. Last May they were underestimating their requirements by large percentages.

The steel price maintenance policy, which is distinctly a Steel Corporation affair in its inception, though participated in by all or nearly all the large independents, is succeeding by main force where it obtains, but does not prevent the smaller producers who desire to do so from securing premiums for early deliveries. There is nothing like a universal policy. Thus the independent tin plate manufacturers, with scarcely an exception, are rigidly pursuing the policy of selling for the first half of 1920 at the March 21 price of \$7 (per base box, 100-lb.), while on the other hand less than half the independent sheet mills are selling, at least in proportion to their respective capacities, at the March 21 prices for sheets, 4.35c for black, 5.70c for galvanized and 3.55c for blue annealed. Some are holding back, while others are openly quoting premium prices.

PIG IRON ADVANCES

The pig iron market at the moment presents all the appearances of a runaway, for striking an average of all grades and districts it is just now advancing at the rate of a dollar a ton or more a week. The runaway may not last long, however, when there is the restraining influence of steel prices being held, for in such a circumstance the steel making grades at any rate cannot advance indefinitely, and the indications are strongly that pig iron advances will not have the support or encouragement of an advance in Lake Superior iron ore for the 1920 season.

In some districts furnaces are selling for the first half of 1920, while in other districts they claim to be doing no more than disposing of the remainder of their prospective make for the first quarter of the year. For nearby deliveries the foundry iron market is approximately as follows: Delivered Philadelphia, \$37.10; at furnace: Buffalo, \$36; Cleveland, \$33; Chicago, \$33; Birmingham, \$33; valley, \$33 to \$35. Bessemer at valley furnace has sold at \$33 to \$35, while basic has been done at \$32.

CONNELLSVILLE COKE

The Connellsville coke trade has been under the threat for a week that production would be restricted for the release of coal for general consumption, and there has been the further stiffening influence of purchases of prompt furnace coke by consumers whose own production of coke has been curtailed by coal scarcity produced by the strike. Prompt furnace coke has ruled strong at \$6.25 in the past week, against an average of about \$3.70 last April, the low month of the year.

Furnace coke contracts for the first half or all of next year have been under negotiation. Operators have claimed a large prospective increase in the cost of production on the ground that the bituminous coal mining scale for the central competitive field was about to experience a large advance, and the Connellsville coke operators would have to advance their mining rates in proportion, also advancing their coke oven labor. The situation now, however, is that Dr. Garfield has prescribed that there must be an advance in the mining scale of 14 per cent, no more and no less, and in the circumstances no large advance in Connellsville coke prices can be predicted upon wages. How this will affect negotiations on furnace coke contracts remains to be seen. The strategic position of coke operators is further weakened by the pronouncement that coal must be held at \$2.35. This would mean a value of about \$3.50 for the coal required to make a ton of coke, and \$6 or \$6.50 for coke, as operators have demanded, would seem out of line. Negotiations have just been concluded on two or three contracts on a ratio basis, 5 to 1 against basic pig iron, valley. At the present \$32 market this would mean \$6.40 for the coke. The brand involved in this case, however, is a particularly desirable one.

The Chemical Market

New York, November 30, 1919.

The shortage of basic materials, which grows more pronounced as the year draws to a close, causes manufacturers to be reluctant about giving estimates, although inquiries are increasing. It is interesting to note that several coal-tar producers are undertaking contracts for 1920, on such standard items as aniline oil and salts. The business of disposing of resale lots has made a quiet market for vegetable oils.

NAVAL STORES

In the naval stores field, rosins on spot are very scarce, E, F, G and H grades being unobtainable. While supplies of rosins are arriving regularly they are needed to fill back deliveries. Inquiries on the medium grades have picked up recently for both domestic and export, the latter interest emanating from Scandinavia, Japan and South America. There are, however, few inquiries for spirits of turpentine, of which it is possible to obtain small lots on spot. The activity in paraffine waxes continues to compensate for the sluggishness of the other waxes. TN and orange, superfine, are practically the only grades of shellac on which dealers are quoting. Due to continued scarcity of supplies and large buying orders from England and the United States the primary market is appreciably higher. Domestic users are not deterred by this situation and there seems to be no limit to the price they will pay for the raw material.

Although during the month there has been considerable buying of crude rubber for January-June and nearby deliveries, the past week has called forth little interest. As is the custom, manufacturers will probably wait until the close of the automobile show and begin their purchasing in January.

The market in England and the Far East is likewise reported easier.

HEAVY CHEMICALS

Sodium bichromate continues to ascend, the minimum figure at this writing being 15½c per lb., and with it goes *formaldehyde*, dealers quoting from 32-35c per lb. Although speculation has played an important part in sending the price of formaldehyde up to the present record level, there is at the same time a stringency on the production end. This is evinced by the statement of an important manufacturer, that owing to the scarcity of basic materials and labor uncertainties he is offering no quotations for deliveries in the next year.

The *caustic soda* market is now controlled by manufacturers. The price of the 76 per cent grade was 4 per cent for export on Tuesday by leading sellers. This makes the export quotation \$3.50 per cwt., less 1 per cent, as against \$3.50, less 5 per cent, which has hitherto prevailed. All indications point to higher prices on this commodity during the coming year.

Sodium prussiate, yellow, which for some time has been in a weak position, appears to be coming into its own again, with present quotations holding firm at 23-24c per lb.

Four hundred tons of *sodium nitrite* arrived on one steamer during the week, and with this addition to present stocks the market is easier at the 14c per lb. quotation. Orders for future deliveries are being taken at 12½-13½c per lb.

As has been the case for the past two weeks, there is practically no spot *ammonium sulphate* to be obtained on the market. As high as \$5.90 per cwt. is being paid for deliveries during the last six months of 1920.

Although practically sold up on their output of *Glauber's salt* for the next three months, manufacturers are open for a few more contracts. On *lithopone* they are sold up for the same period. The price on lithopone during the last quarter of 1920 is expected to be around 8 or 9c per lb. The price for the first quarter is given at 7-7½c. One manufacturer is holding the contract price on *Glauber's salt* at \$1.15 per cwt. in bags, and \$1.25 in barrels, while another is shading these figures to \$1.10 in bags and \$1.15 in barrels.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, NOV. 30, 1919

	Carlots	Less Carlots
Acetic anhydride.....lb.	\$0.134-\$0.14	\$0.60-\$0.65
Acetone.....lb.	2.50-2.65	15-15 1/2
Acid, acetic, 28 per cent.....cwt.	5.00-5.50	3.00-3.25
Acetic, 56 per cent.....cwt.	12.00-12.50	6.00-6.50
Acetic, glacial, 99 1/2 per cent, carboys.....cwt.	12.00-12.50	12.90-13.50
Boric, crystals.....lb.	12-13 1/2	13-14
Boric, powder.....lb.	12-13 1/2	13-14
Hydrochloric, (muriatic) tech. 20 deg.....cwt.	1.50-1.75	2.00-2.50
Hydrofluoric, 52 deg.....lb.	12-14	14-16
Lactic, 44 per cent. tech.....lb.	11-14	12-16
Lactic, 22 per cent. tech.....lb.	05-06	05 1/2-07
Molybdic, C. P.....lb.	4.00-4.25	4.00-4.25
Nitric, 40 deg.....lb.	06-06 1/2	07-08 1/2
Nitric, 42 deg.....lb.	07-07 1/2	08-09
Oxalic, crystals.....lb.	22-24	25-30
Phosphoric, Ortho, 50 per cent. solution.....lb.	10-11	11-14
Picric.....lb.	30-35	40-50
Pyrogallol, resublimed.....lb.	2.30-2.60	2.30-2.60
Sulphuric, 60 deg., tank cars.....ton	12.00-16.00	22.00-
Sulphuric, 60 deg., drums.....ton	17.00-	25.00-
Sulphuric, 60 deg., carboys.....ton	20.00-	22.00-23.00
Sulphuric, 66 deg., tank cars.....ton	17.00-18.00	25.00-26.00
Sulphuric, 66 deg., drums.....ton	20.00-21.00	30.00-40.00
Sulphuric, 66 deg., carboys.....ton	25.00-	30.00-40.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars.....ton	20.00-	26.00-
Sulphuric, fuming, 20 per cent. (oleum) drums.....ton	25.00-	32.00-
Sulphuric, fuming, 20 per cent. (oleum) carboys.....ton	30.00-	35.00-
Tannic, U. S. P.....lb.	1.35-1.45	1.35-1.45
Tannic (tech.).....lb.	42-55	42-55
Tartaric, crystals.....lb.	72-74	72-74
Tungstic, per lb. of WO.....lb.	1.20-1.40	1.20-1.40
Alcohol, Ethyl.....gal.	4.90-	4.95-
Alcohol, Methyl.....gal.	1.40-	1.43-
Alcohol, denatured, 188 proof.....gal.	58-60	60-64
Alcohol, denatured, 190 proof.....gal.	54-56	56-60
Alum, ammonia lump.....lb.	03 1/2-04 1/2	04 1/2-04 1/2
Alum, potash lump.....lb.	07 1/2-07 1/2	08-09
Alum, chrome lump.....lb.	15-16	18-20
Aluminum sulphate, commercial.....lb.	01 1/2-02	02 1/2-02 1/2
Aluminum sulphate, iron free.....lb.	02 1/2-03	03 1/2-03 1/2
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	08-	08 1/2-08 1/2
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.	08-	30-35
Ammonium carbonate, powder.....lb.	13-13 1/2	14-14 1/2
Ammonium chloride, granular (white sal-ammoniac).....lb.	12 1/2-13	13 1/2-14
Ammonium chloride, granular (gray sal-ammoniac).....lb.	12-12 1/2	13-13 1/2
Ammonium nitrate.....lb.	10-11	11-12
Ammonium sulphate.....lb.	06 1/2-	06 1/2-
Amyl acetate.....gal.	3.65-3.75	3.65-3.75
Arsenic, oxide, lumps (white arsenic).....lb.	104-11	104-11
Arsenic, sulphide, powdered (red arsenic).....lb.	23-24	23-24
Barium chloride.....ton	85.00-	90.00-100.00
Barium dioxide (peroxide).....lb.	22-	24-
Barium nitrate.....lb.	10-10 1/2	11-12
Barium sulphate (precip.) (blanc fixe).....lb.	03-03 1/2	03 1/2-04
Bleaching powder (see calcium hypochlorite).....lb.	-	-
Blue Vitriol (see copper sulphate).....lb.	-	-
Borax (see sodium borate).....lb.	-	-
Brimstone (see sulphur, roll).....lb.	-	-
Bromine.....lb.	65-75	65-75
Calcium acetate.....cwt.	2.00-2.05	2.10-
Calcium carbide.....lb.	04 1/2-05	04 1/2-05
Calcium chloride, fused, lump.....ton	19.00-25.00	30.00-40.00
Calcium chloride, granulated.....lb.	01 1/2-01 1/2	02-02 1/2
Calcium hypochlorite (bleaching powder).....cwt.	2.25-2.50	2.25-2.50
Calcium peroxide.....lb.	1.50-1.70	1.50-1.70
Calcium phosphate, monobasic.....lb.	75-	75-
Calcium sulphate, precipitated.....lb.	09-09 1/2	09-09 1/2
Carbon bisulphide.....lb.	06-06 1/2	06 1/2-07
Carbon tetrachloride, drums.....lb.	10-11	12-14
Carbonyl chloride (phosgene).....lb.	75-	75-
Caustic potash (see potassium hydroxide).....lb.	-	-
Caustic soda (see sodium hydroxide).....lb.	-	-
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	05-05 1/2	08-
Cobalt oxide.....lb.	1.50-1.55	1.50-1.55
Copperas (see iron sulphate).....lb.	-	-
Copper carbonate, green precipitate.....lb.	28-31	28-31
Copper cyanide.....lb.	65-70	65-70
Copper sulphate, crystals.....lb.	08 1/2-08 1/2	09-09 1/2
Cream of tartar (see potassium bitartrate).....lb.	-	-
Epsom salt (see magnesium sulphate).....lb.	-	-
Formaldehyde, 40 per cent.....lb.	19-33	19-33
Glauber's salt (see sodium sulphate).....lb.	-	-
Glycerine.....lb.	20 1/2-21	20 1/2-21
Iodine, resublimed.....lb.	4.50-	4.50-
Iron oxide, red.....lb.	03-20	03-20
Iron sulphate, (copperas).....cwt.	1.25-	1.35-1.50
Lead acetate, normal.....lb.	12 1/2-14 1/2	12 1/2-14 1/2
Lead arsenate (paste).....lb.	13-17	13-17
Lead nitrate, crystals.....lb.	85-86 1/2	85-86 1/2
Litharge.....lb.	09 1/2-10 1/2	09 1/2-10 1/2
Lithium Carbonate.....lb.	50-	50-
Magnesium carbonate, technical.....lb.	13-14 1/2	13-14 1/2
Magnesium sulphate, U. S. P.....100 lb.	2.00-2.63	2.75-3.00
Magnesium sulphate, commercial.....100 lb.	1.75-	2.00-2.50
Nickel salt, double.....lb.	14-15	15-16
Nickel salt, single.....lb.	12-15	15-16
Phosgene (see carbonyl chloride).....lb.	-	-
Phosphorus, red.....lb.	60-70	60-70
Phosphorus, yellow.....lb.	35-37	35-37
Potassium bichromate.....lb.	26 1/2-27	28-28 1/2
Potassium bitartrate (cream of Tartar).....lb.	55-60	55-60
Potassium bromide, granular.....lb.	74-	74-
Potassium carbonate, U. S. P.....lb.	55-60	60-65
Potassium carbonate, crude.....lb.	23-27	27-30
Potassium chlorate, crystals.....lb.	18-20	21-
Potassium cyanide, 98-99 per cent.....lb.	nominal	30-31
Potassium hydroxide (caustic potash).....lb.	25-28	30-31
Potassium iodide.....lb.	3.55-3.60	3.55-3.60
Potassium nitrate.....lb.	19-	21-
Potassium permanganate.....lb.	51-58	51-58
Potassium prussiate, red.....lb.	1.05-1.15	1.05-1.15

	Carlots	Less Carlots
Potassium prussiate, yellow.....lb.	225.00-	40-44
Potassium sulphate.....ton	225.00-	-
Rochelle salts (see sodium potas. tartrate).....lb.	-	-
Sal ammoniac (see ammonium chloride).....lb.	-	-
Salt cake (see sodium carbonate).....lb.	-	-
Salt cake (sodium sulphate).....ton	17.00-21.00	-
Silver cyanide.....oz.	1.19-	80 1/2-81 1/2
Silver nitrate.....oz.	1.90-2.05	2.10-2.50
Soda ash, light.....100 lb.	2.15-2.25	2.30-2.50
Soda ash, dense.....100 lb.	06 1/2-07	07 1/2-08
Sodium acetate.....lb.	2.35-	2.75-3.00
Sodium bicarbonate.....100 lb.	15 1/2-16	17-17 1/2
Sodium bichromate.....lb.	3.00-8.00	10.00-
Sodium bisulphate (nitre cake).....ton	1.80-1.90	2.08-2.10
Sodium bisulphite.....cwt.	07 1/2-	08-08 1/2
Sodium borate (borax).....lb.	1.35-1.50	1.50-1.75
Sodium carbonate (sal soda).....100 lb.	12-13	13-14
Sodium chlorate.....lb.	30-	31-34
Sodium cyanide, 96-98 per cent.....lb.	15-	16-17
Sodium fluoride.....lb.	3.35-3.40	3.45-3.50
Sodium hydroxide (caustic soda).....100 lb.	2.50-	3.25-
Sodium molybdate.....100 lb.	2.87 1/2-3.25	3.75-4.00
Sodium nitrate.....lb.	14-15	16-16 1/2
Sodium peroxide, powdered.....lb.	03 1/2-04	04 1/2-05
Sodium phosphate, dibasic.....lb.	23-25	26-27
Sodium potassium tartrate (Rochelle salts).....lb.	01 1/2-02	02-02 1/2
Sodium silicate, solution (40 deg.).....lb.	02 1/2-03	03 1/2-04 1/2
Sodium silicate, solution (60 deg.).....lb.	1.15-1.25	1.50-2.00
Sodium sulphate, crystals (Glauber's salts) cwt.	-	-
Sodium sulphide, crystal, 60-62 per cent. (conc.).....lb.	-	05-06
Sodium sulphite, crystals.....lb.	03 1/2-	04-06
Strontium nitrate, crystals.....lb.	05 1/2-	06-06 1/2
Sulphur chloride, crystals.....lb.	22.00-	10-12
Sulphur, crude.....ton	-	3.40-3.65
Sulphur dioxide, liquid, cylinders.....lb.	3.10-	3.15-3.40
Sulphur (sublimed), flour.....100 lb.	2.95-	46-50
Sulphur, roll (brimstone).....100 lb.	44-	60-60
Tin bichloride (stannous).....lb.	12 1/2-	20-20
Tin oxide.....lb.	49-	13 1/2-14
Zinc carbonate, precipitate.....lb.	09-11	09 1/2-09 1/2
Zinc chloride, gran.....lb.	03 1/2-03 1/2	04-04 1/2
Zinc cyanide.....lb.	-	-
Zinc dust.....lb.	-	-
Zinc oxide, dry American.....lb.	-	-
Zinc sulphate.....lb.	-	-

Coal-Tar Products

NOTE-The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.00-	\$1.10
Alpha naphthol, refined.....lb.	1.40-	1.50
Alpha naphthylamine.....lb.	35-	30
Aniline oil, drums extra.....lb.	34-	38
Aniline salts.....lb.	36-	42
Anthracene, 80% in drums (100 lb.).....lb.	90-	1.00
Benzaldehyde (f.f.c.).....lb.	1.00-	1.15
Benzidine, base.....lb.	1.10-	1.25
Benzidine, sulphate.....lb.	95-	1.15
Benzoic acid, U. S. P.....lb.	90-	1.10
Benzoate of soda, U. S. P.....lb.	80-	1.00
Benzol, pure, water-white, in drums (100 lb.).....gal.	36-	36
Benzol, 90% in drums (100 lb.).....gal.	24-	28
Benzyl chloride, 95-97%, refined.....lb.	35-	40
Benzyl chloride, tech.....lb.	25-	35
Beta naphthol benzoate.....lb.	3.75-	4.50
Beta naphthol, sublimed.....lb.	75-	80
Beta naphthol, tech.....lb.	47-	55
Beta naphthylamine, sublimed.....lb.	2.25-	2.35
Cresol, U. S. P., in drums (100 lb.).....lb.	18-	25
Ortho-cresol, in drums (100 lb.).....lb.	23-	25
Cresylic acid, 97-99%, straw color, in drums.....gal.	80-	85
Cresylic acid, 95-97%, dark, in drums.....gal.	85-	90
Cresylic acid, 50%, first quality, drums.....gal.	60-	60
Dichlorobenzol.....lb.	07-	10
Diethylaniline.....lb.	1.40-	2.25
Dimethylaniline.....lb.	57-	60
Dinitrobenzol.....lb.	27-	37
Dinitrochlorobenzol.....lb.	25-	30
Dinitronaphthalene.....lb.	45-	55
Dinitrophenol.....lb.	27-	36
Dinitrotoluol.....lb.	38-	45
Dip oil, 25%, tar acids, car lots, in drums.....gal.	38-	65
Diphenylamine.....lb.	58-	70
H-acid.....lb.	1.55-	1.70
Metaphenylenediamine.....lb.	1.10-	1.25
Monochlorobenzol.....lb.	12-	15
Monothylaniline.....lb.	1.50-	1.75
Naphthalene crushed, in bbls. (250 lb.).....lb.	06-	08
Naphthalene, flake.....lb.	06 1/2-	07 1/2
Naphthalene, balls.....lb.	08 1/2-	10
Naphthionic acid, crude.....lb.	75-	1.25
Nitrobenzol.....lb.	14-	19
Nitro-naphthalene.....lb.	35-	45
Nitro-toluol.....lb.	40-	50
Ortho-amidophenol.....lb.	3.75-	4.25
Ortho-dichlor-benzol.....lb.	15-	20
Ortho-nitro-phenol.....lb.	90-	1.25
Ortho-nitro-toluol.....lb.	25-	40
Ortho-toluidine.....lb.	25-	32
Para-amidophenol, base.....lb.	2.75-	3.50
Para-amidophenol, HCl.....lb.	2.75-	3.25
Para-dichlor-benzol.....lb.	15-	18
Paranitraniline.....lb.	1.10-	1.20
Para-nitro-toluol.....lb.	1.35-	1.50
Paraphenylenediamine.....lb.	2.50-	3.00
Paratoluidine.....lb.	2.00-	2.25
Phthalic anhydride.....lb.	1.00-	1.50
Phenol, U. S. P., drums (dest.), (240 lb.).....lb.	18-	18
Pyridin.....gal.	2.50-	3.75
Resorcin, technical.....lb.	3.50-	6.75
Resorcin, pure.....lb.	6.50-	6.75
Salicylic acid, tech., in bbls. (110 lb.).....lb.	45-	50
Salicylic acid, U. S. P.....lb.	55-	60
Salol.....lb.	90-	95
Solvent naphtha, water-white, in drums, 100 gal. gal.	20-	27
Solvent naphtha, crude, heavy, in drums, 100 gal. gal.	18-	42
Sulphanilic acid, crude.....lb.	26-	30

Tolidine.....	lb.	\$1.70	—	\$2.50
Toluidine, mixed.....	lb.	.45	—	.55
Toluol, in tank cars.....	gal.	.27	—	.30
Toluol, in drums.....	lb.	.28	—	.30
Xylidine, drums, 100 gal.....	lb.	.44	—	.50
Xylol, pure, in drums.....	gal.	.37	—	.45
Xylol, pure, in tank cars.....	gal.	.35	—	.40
Xylol, commercial, in drums, 100 gal.....	gal.	.23	—	.27
Xylol, commercial, in tank cars.....	gal.	.22	—	.25

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow.....	lb.	\$0.41	—	\$0.43
Beeswax, refined, yellow.....	lb.	.48	—	.51
Beeswax, white pure.....	lb.	.65	—	.68
Carnauba, No. 1.....	lb.	.84	—	.86
Carnauba, No. 2, regular.....	lb.	.75	—	.78
Carnauba, No. 3, North Country.....	lb.	.46	—	.47
Japan.....	lb.	.19½	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb.	.06	—	.07
Paraffine waxes, crude, scale 124-126 m.p.....	lb.	.06½	—	.07
Paraffine waxes, refined, 118-120 m.p.....	lb.	.08½	—	.09
Paraffine waxes, refined, 128-130 m.p.....	lb.	.09½	—	.09½
Paraffine waxes, refined, 133-135 m.p.....	lb.	.11	—	.11½
Paraffine waxes, refined, 135-137 m.p.....	lb.	.12	—	.13½
Stearic acid, single pressed.....	lb.	.23	—	.26
Stearic acid, double pressed.....	lb.	.28	—	.29
Stearic acid, triple pressed.....	lb.	.32	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940.....	gal.	\$1.10	—	
Pine oil, pure, dest. dist.....	gal.	.96	—	
Pine tar oil, ref., sp. gr. 1.025-1.035.....	gal.	.45	—	
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.34	—	
Pine tar oil, double ref., sp. gr. 0.965-0.990.....	gal.	.65	—	
Pine tar, ref., thin, sp. gr. 1.080-1.960.....	gal.	.38	—	
Turpentine, crude, sp. gr. 0.900-0.970.....	gal.	.85	—	
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990.....	gal.	.30	—	
Pinewood creosote, ref.....	gal.	.48	—	

Naval Stores

The following prices are f.o.b. New York, for carload lots.

Rosin B-D, bbl.....	280 lb.	\$17.25	—	\$17.65
Rosin E-I.....	280 lb.	17.75	—	18.75
Rosin K-N.....	280 lb.	19.75	—	22.25
Rosin W. G.-W. W.....	280 lb.	22.50	—	24.00
Wood rosin, bbl.....	280 lb.	17.00	—	17.50
Spirits of turpentine.....	gal.	1.68	—	
Wood turpentine, steam dist.....	gal.	1.50	—	
Wood turpentine, dest. dist.....	gal.	1.48	—	
Pine tar pitch, bbl.....	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.).....	bbl.	14.50	—	14.75
Retort tar, bbl.....	280 lb.	15.00	—	
Rosin oil, first run.....	gal.	.86	—	.91
Rosin oil, second run.....	gal.	.88	—	.93
Rosin oil, third run.....	gal.	.95	—	1.10
Rosin oil, fourth run.....	gal.	1.05	—	1.15

Solvents

73-76 deg., steel bbls. (85 lb.).....	gal.	\$0.33½	—	
70-72 deg., steel bbls. (85 lb.).....	gal.	.31½	—	
68-70 deg., steel bbls. (85 lb.).....	gal.	.30½	—	
V. M. and P. naphtha, steel bbls. (85 lb.).....	gal.	.23½	—	

Crude Rubber

Para-Upriver fine.....	lb.	\$0.49½	—	\$0.49½
Upriver coarse.....	lb.	.34½	—	.35½
Upriver caucho ball.....	lb.	.34½	—	.35½
Plantation—First latex crepe.....	lb.	.52	—	.53½
Ribbed smoked sheets.....	lb.	.51½	—	.52½
Brown crepe, thin, clean.....	lb.	.46½	—	.47½
Amber crepe No. 1.....	lb.	.50	—	.51

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.....	lb.	\$0.18½	—	\$0.19
Castor oil, AA, in bbls.....	lb.	.21½	—	.22
China wood oil, in bbls.....	lb.	.22½	—	.23
Cocoonut oil, Ceylon grade, in bbls.....	lb.	.17½	—	.18
Cocoonut oil, Cochon grade, in bbls.....	lb.	.19½	—	.20
Corn oil, crude, in bbls.....	lb.	.18	—	.18½
Cottonseed oil, crude (f.o.b. mill).....	lb.	.18½	—	.18½
Cottonseed oil, summer yellow.....	lb.	.23½	—	.24
Cottonseed oil, winter yellow.....	lb.	.24½	—	.25
Linseed oil, raw, car lots.....	gal.	1.77	—	
Linseed oil, raw, tank cars.....	gal.	1.72	—	
Linseed oil, boiled, car lots.....	gal.	1.79	—	
Olive oil, commercial.....	gal.	2.50	—	2.80
Palm, Lagos.....	lb.	.17	—	.17½
Palm, bright red.....	lb.	.16½	—	.17½
Palm, Niger.....	lb.	.16	—	.18
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.23½	—	.23½
Peanut oil, refined, in bbls.....	lb.	.26½	—	.27
Rapeseed oil, refined in bbls.....	gal.	1.45	—	1.50
Rapeseed oil, blown, in bbls.....	gal.	1.60	—	
Soya bean oil (Manchurian), in bbls., N. Y.....	lb.	.17½	—	.18½
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.15½	—	.15½

FISH

Winter pressed Menhaden.....	gal.	\$1.20	—	
Yellow bleached Menhaden.....	gal.	1.23	—	
White bleached Menhaden.....	gal.	1.25	—	
Blown Menhaden.....	gal.	1.30	—	

Miscellaneous Materials

All Prices f.o.b., N. Y.

Sarytes, domestic, white, floated.....	ton	\$35.00	—	\$40.00
Sarytes, off color.....	ton	20.00	—	25.00
Plane fixe, dry.....	lb.	.03½	—	.04½
Plane fixe, pulp.....	ton	47.50	—	50.00
Sawdust.....	lb.	.16	—	.18
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.04½	—	.06

Chalk, English, dense.....	lb.	\$.04	—	\$.05
China clay (Kaolin), imported, lump.....	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered.....	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump.....	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered.....	ton	25.00	—	40.00
Felspar.....	ton	13.50	—	17.00
Fluorspar, acid grade, lump, f.o.b. mines.....	net ton	30.00	—	35.00
Fluorspar, acid grade, ground, f.o.b. mines.....	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered.....	ton	25.00	—	30.00
Fuller's earth, imported, powdered.....	ton	35.00	—	40.00
Pumice stone, imported.....	lb.	.03	—	.06
Pumice stone, domestic.....	lb.	.02½	—	
Shellac, TN.....	lb.	1.10	—	1.15
Shellac, D. C.....	lb.		—	
Shellac, V. S. O.....	lb.		—	
Shellac, Diamond I.....	lb.		—	
Shellac, orange, fine.....	lb.	1.25	—	
Shellac, orange, superfine.....	lb.	1.20	—	1.30
Shellac, A. C. garnet.....	lb.	1.10	—	
Shellac, bleached, bone dry.....	lb.	1.35	—	
Shellac, bleached, fresh ground.....	lb.	1.10	—	1.15
Soapstone.....	ton	15.00	—	25.00
Talc, domestic.....	ton	16.00	—	60.00
Talc, imported.....	ton	60.00	—	70.00

Refractories

Following prices are f.o.b. works:

Chrome brick.....	net ton	80-90 at Chester, Penn.	
Chrome cement.....	net ton	45-50 at Chester, Penn.	
Clay brick, 1st quality fireclay.....	1,000	35-45 at Clearfield, Penn.	
Clay brick, 2nd quality.....	1,000	30-35 at Clearfield, Penn.	
Magnesite, dead burned.....	net ton	50-55 at Chester, Penn.	
Magnesite brick, 9 x 4½ x 2½ in.....	net ton	80-90 at Chester, Penn.	
Silica brick.....	1,000	41-45 at Mt. Union, Penn.	

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon.....	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon.....	lb.	.70	—	
Ferro-manganese, 70-80% Mn.....	gross ton	110.00	—	115.00
Spiegelisen, 16-20% Mn.....	gross ton	33.00	—	36.00
Ferro-molybdenum, per lb. of Mo.....	lb.	2.50	—	3.00
Ferro-silicon, 50%.....	gross ton	85.00	—	95.00
Ferro-silicon, 75%.....	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%.....	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.....	lb.	1.25	—	1.40
Ferro-uranium, 35-50%, of U.....	lb.	7.00	—	
Ferro-vanadium, 30-40% per lb. of contained V.....	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40%, Cr ₂ O ₃	unit	\$0.60	—	\$0.80
Chrome ore, 48% and over.....	unit	.90	—	1.00
Coke, foundry, f.o.b. ovens.....	net ton	7.00	—	7.50
Coke, furnace, f.o.b. ovens.....	net ton	6.00	—	6.50
Petroleum coke, refinery, Atlantic seaboard.....	net ton	12.00	—	12.50
Fluorspar, gravel, f.o.b. mines.....	net ton		—	25.00
Manganese ore, 45% Mn and over.....	unit	.50	—	.75
Manganese ore, chemical (MnO ₂).....	gross ton	60.00	—	70.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	9.00	—	15.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃	unit	7.50	—	10.00
Uranium oxide, 96%.....	unit	2.75	—	3.00
Vanadium pentoxide, 99%.....	lb.	6.00	—	
Pyrites, foreign, lump.....	unit	.17	—	
Pyrites, foreign, fine.....	unit	.17	—	
Pyrites, domestic, fine.....	unit	.16	—	.17½
Ilmenite, 32% TiO ₂	lb.	.02	—	
Rutile, 95% TiO ₂	lb.	.11	—	
Carotite, minimum 2% U ₃ O ₈ , per lb. of U ₃ O ₈	lb.	2.75	—	3.00
Zircon, washed, iron free.....	lb.	.10	—	
Monazite, per unit of ThO ₃	unit	42.00	—	

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags.....	bbl.	\$2.80	—	
Lump lime, common, including container.....	300 bbl.	2.65	—	
Common brick, at dock.....	lb.	76.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under.....	M.	48.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago.....	M.	50.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis.....	M.	40.00	—	
Roofings, tar felt (14 lb. per 100 sq. ft.).....	ton	70.00	—	
Roofings, tar pitch (in 400-lb. bbl.) carlots.....	ton	21.00	—	
Roofings, asphalt pitch carlots.....	ton	34.00	—	
Roofings, asphalt felt carlots.....	ton	63.00	—	
Roofings, slate-surfaced, per roll of 108 sq. ft. carlots.....		2.25	—	
Roofings, slate-finished shingles, 100 sq. ft. carlots.....		6.00	—	
Linseed oil, raw in barrels.....	gal.	1.75	—	
Linseed oil, 5 gal. cans.....	gal.	1.90	—	
Red lead, dry, 100 lb. keg.....	lb.	13	—	
Red lead, in oil, 100 lb. keg.....	lb.	14½	—	
Red lead, dry, 5 lb. cans.....	lb.	15	—	
Red lead, in oil, 5 lb. cans.....	lb.	16½	—	
White lead, dry and in oil, 100 lb. keg.....	lb.	13	—	
White lead, dry and in oil, 25 and 50 lb. kegs.....	lb.	13½	—	
White lead, dry and in oil, 5 lb. cans.....	lb.	15	—	

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.....	100 lb.	\$2.45	—	
Angles, 3 to 6-in., ½-in. thick.....	100 lb.	2.45	—	
Tees, 3-in. and larger.....	100 lb.	2.45	—	
Plates.....	100 lb.	2.66	—	
Rivets, structural, ½-in. and larger.....	100 lb.	4.20	—	
Rivets, conehead for boilers, ½-in. and larger.....	100 lb.	4.30	—	
Sheets, No. 28 black.....	100 lb.	4.35	—	
Sheets, No. 10 blue annealed.....	100 lb.	3.55	—	
Sheets, No. 28 galvanized.....	100 lb.	5.70	—	

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

INDUSTRIAL

Financial, Construction and Manufacturers' News

Construction and Operation

NOTE—These items were compiled as of Nov. 29, but appear in this issue due to the delay in publication due to the printers' strike.

Alabama

FAIRFAX—The Fairfax Mills plan to build a 75 x 163-ft. bleachery. J. E. Sirrine, Gillsville, S. C., engineer.

Arizona

AJO—The New Cornelia Copper Co. plans to build a 10,000-ton flotation and smelter plant to treat its sulphide ore body. John G. Greenway, general manager.

PHOENIX—Hiram Phillips, engineer, 801 International Life Bldg., will receive bids in December for the construction of a complete "gravity infiltration system." Project includes the erection of a 21 x 400 x 400-ft. reservoir, etc. The company will be in the market for extensive pressure reducing apparatus. Estimated cost, \$2,000,000.

Arkansas

ARKANSAS CITY—G. A. Shryock, 306 East Douglas Ave., Wichita, Kans., has awarded the contract for the construction of a 1-story gasoline extraction plant, to Westinghouse, Church, Kerr, Inc., 37 Wall St., New York City. Estimated cost, \$60,000.

Colorado

FT. COLLINS—The Agricultural College has awarded the contract for the construction of a 3-story, 52 x 106-ft. physics building, to Edward Reavill, 1435 Vine St., Denver. Estimated cost, \$93,533. Noted Oct. 15.

Connecticut

BRIDGEPORT—The Bridgeport Brass Co., Grand St., has awarded the contract for the construction of a 1-story, 150 x 220-ft. castings shop on Grand St., to Levering & Garrigues Co., 552 West 23rd St., New York City. Estimated cost, \$150,000. Noted Sept. 1.

MIDDLETOWN—The Trustees of Wesleyan University, 374 High St., will receive bids until Dec. 1 for the construction of a 2-story, 100 x 157-ft. laboratory on the campus. Estimated cost, \$300,000. Henry Bacon, 101 Park Ave., New York City, architect. Noted July 1.

OAKVILLE—The Oakville Co., manufacturer of brass goods, has awarded the contract for the construction of a 1-story, 44 x 56-ft. steam turbine building on Oakville St., to Fred T. Ley & Co., Inc., 499 Main St., Springfield, Mass. Estimated cost, \$20,000.

Idaho

BUHL—The city is having preliminary plans prepared for the construction of a waterworks system. Estimated cost, \$10,000. H. E. Lindon, 593 Market St., San Francisco, engineer.

Illinois

CHICAGO—The Fitzsimons Steel & Iron Co., West 37th St. and Racine Ave., has purchased a site at 33rd St. and Kedzie Ave., and plans to construct a modern 1-story plant for the manufacture of cold-drawn steel shapes. Estimated cost, \$300,000.

CHICAGO—The Northwestern Terra Cotta Co., 2525 Claybourne Ave., has awarded the contract for the construction of a plant, consisting of 4 buildings, one 1-story, 240 x 325 ft., one 3-story, 84 x 325-ft., one 1-story, 145 x 155-ft. and one 1-story, 45 x 58-ft., on Claybourne Ave., near Western Ave., to Gerhardt F. Meyne, 127 North Dearborn St. Estimated cost, \$225,000.

Iowa

DES MOINES—Frank Jeffries, city clerk, will soon award the contract for the construction of the Waveland Park sanitary sewer, small septic tank, and filter bed. Estimated cost, \$25,000. K. C. Kastburg, city engineer.

POCAHONTAS—The city has awarded the contract for the construction of a disposal plant in connection with the proposed sewerage system, to B. D. Viegell, Webster City, \$21,900. Noted Sept. 1.

Kansas

HUTCHINSON—The Solvay Process, Milton Ave., Syracuse, N. Y., is having plans prepared for the construction of a soda ash plant, consisting of 3 buildings. Estimated cost, \$750,000.

NEADESHA—The Standard Oil Co. of Kansas will soon award the contract for the construction of a refinery to consist of 40 additional stills, additional tanks with a capacity of 300,000 bbl., etc.

Kentucky

ASHLAND—The Board of Water Commissioners has awarded the contract for the construction of a 2,000,000-gal. filtration plant, etc., to Joseph E. Nelson & Sons, 117 North La Salle St., Chicago, Ill. Noted July 15.

Maryland

BALTIMORE—The Kaufman Beef Co., 6th St. and Union Stock Yards, is having plans prepared for the construction of a 3-story, 150 x 150-ft. packing house. Estimated cost, \$150,000. C. H. A. Wannewetsch, William St., Buffalo, N. Y., architect.

CURTIS BAY (Baltimore P. O.)—The Armour Fertilizer Co., 1501 Munsey Bldg., Baltimore, has purchased a 20-acre site here, and plans to construct a fertilizer plant on same. Estimated cost, \$2,000,000.

CURTIS BAY (Baltimore P. O.)—The Standard Guano Co., 1214 Continental Bldg., Baltimore, will soon award the contract for the construction of an acid plant, consisting of four or five 1-story buildings and a 40 x 200 ft. pier, on Aspen St. and Pennington Ave., here. Estimated cost, \$300,000. W. W. Pagon, Lexington Bldg., Baltimore, engineer.

ELKTON—The Town Commissioners plan to install a filtration plant and sewerage system, also enlarge the water mains. Bonds amounting to \$80,000 will be issued for this project. L. J. Houston, Jr., 603 Parkwyth Ave., Baltimore, Md., and Fredricksburg, Va., engineer.

Massachusetts

CHICOPEE FALLS—The Fisk Rubber Co. has awarded the contract for the construction of a 1-story, 23 x 115-ft. factory addition and a 23 x 40-ft. electrical substation addition at its plant, here, to F. T. Ley & Co., Inc., 499 Main St., Springfield. Estimated cost, \$30,000.

FITCHBURG—Crocker, Burbank & Co., Inc., 545 Westminster St., manufacturer of paper, has awarded the contract for the construction of a 2-story, 60 x 200-ft. factory on Westminster St., to Foss & Jones, 75 Laurel St. Estimated cost, \$100,000. Noted July 1.

MILLBURY—The City of Worcester plans to construct a sewage disposal plant, here. Estimated cost, \$250,000. Address Engineering Department, Worcester.

NEW BEDFORD—The New England Refining Co., Boston, has awarded the contract for the construction of a refinery on Harbor St., to F. T. Ley & Co., Inc., 499 Main St., Springfield. Estimated cost, \$250,000.

NORTHAMPTON—Smith College plans to construct a physics and geology building on the college grounds. Estimated cost, \$150,000. W. A. Neilson, president.

WOBURN—The Buckman Tanning Co. is having preliminary plans prepared for a reinforced-concrete sewage disposal tank and reclamation of tannery sludge. Estimated cost, \$15,000. Vaughn & Meyer, Security Bldg., Milwaukee, engineer.

Michigan

BATTLE CREEK—The Battle Creek Paper Co. has awarded the contract for the construction of a 2-story, 110 x 210-ft. addition to its paper factory at 81 Garrison St., to Witherspoon & Englar, 53 West Jackson Blvd., Chicago, Ill. Estimated cost, \$175,000.

DETROIT—The Detroit Grey Iron Foundry Co. will soon award the contract for the construction of a 2-story, 135 x 150-ft. foundry addition on Wight St. Mildner & Eisen, 924 Hammond Bldg., architects.

DETROIT—The Detroit Lubricator Co., Marquette Ave., has awarded the contract for the construction of a 3-story, 90 x 124-ft. factory, on Marquette and Trumbull Aves., to Walbridge-Aldinger Co., 2356 Penobscot Bldg.

DETROIT—A. J. Detlaff, 121 Lafayette St., E., plans to construct 1 and 2-story foundries and a machine shop on Grand River Ave. and the Terminal Railway. Architect not selected.

DETROIT—The Western Gear Manufacturing Co., 1040 Scotten Ave., is having plans prepared for the construction of a 1-story, 40 x 80-ft. heating plant on Scotten Ave. Cyanide furnaces and equipment will be installed in same. Estimated cost, \$30,000. Louis Scisorek, 225 Farwell Bldg., architect and engineer.

LANSING—The city has engaged Alvord & Burdick, engineers, Hartford Bldg., Chicago, Ill., to prepare report on tentative plans and submit estimates for the proposed filtration plant.

MARYSVILLE—The city engaged Smith, Hinchman & Grylls, engineers, 710 Washington Arcade, Detroit, to prepare plans for the construction of a complete sewerage system on Huron Blvd., and other streets, for a townsite to be planned for 100,000 inhabitants, to include sewage treatment works, trunk sewers and laterals, and probably a battery of Imhoff tanks.

MARYSVILLE—The Pressed Metals of Canada, 112 Adelaide St., Toronto, Ont., has awarded the contract for the construction of a 2-story, 72 x 516-ft. brass foundry, along the St. Clair River, to the Witherspoon & Englar Co., 53 West Jackson Blvd., Chicago, Ill. Estimated cost, \$95,000. Noted Sept. 23.

MARYSVILLE—The Wills-Lee Co., Book Bldg., Detroit, has awarded the contract for the construction of a 1-story, 72 x 370-ft. cyanide treatment building on Huron Rd., to the Walbridge-Aldinger Co., 2356 Penobscot Bldg., Detroit.

PONTIAC—The city engaged C. W. Hubbell, engineer, 2348 Penobscot Bldg., Detroit, to prepare plans for water filtration plant at site on Walnut St., to treat lake water for additional supply. Sand filter having capacity of 10,000,000 gal. per day will be designed.

Minnesota

ADRIAN—The city has awarded the contract for the construction of a sewerage system, septic tank, sludge bed and accessories, to Kircher Brothers, Olivia, at \$45,750. Noted Sept. 25.

AUSTIN—The Board of Education has awarded the contract for the construction of a 3-story, 290 x 300-ft. high school, to the Madison Construction Co., Builders' Exchange, Minneapolis. A chemical laboratory will be installed in same. Estimated cost, \$450,000.

AUSTIN—The Board of Education will soon award the contract for the installation of a water softening system in the proposed school. Estimated cost, \$32,000. Frank Tustison, Auditorium, Minneapolis, engineer.

FOLEY—The city has awarded the contract for the construction of a sewerage system and disposal plant, to the Pastoret Construction Co., 510 Lyceum Bldg., Duluth. Noted Sept. 14.

ST. PAUL—The St. Paul Welding Co., 173 West 3rd St., has awarded the contract for the construction of a 2-story, 36 x 75-ft. welding shop, to Lauer Bros., Chestnut St. Estimated cost, \$115,000. Noted Sept. 1.

ST. PAUL—The Western Chemical Co., 443 South Dearborn St., Chicago, Ill., has purchased a site on 30th St. and University Ave., and plans to build a factory and office on same. Estimated cost, \$100,000.

Mississippi

CLARKSDALE—D. W. Richberger, 126 South 2nd St., Memphis, Tenn., and others have formed a company for the purpose of

building a plant to supply gas to this town. Estimated cost, \$10,000. An election will be held to determine whether citizens will accept proposition. J. H. Weatherford, Porter Bldg., Memphis, Tenn., engineer.

Missouri

HANNIBAL—The Hannibal Rubber Co. has awarded the contract for the construction of a rubber plant, to Burgher Bros., Hannibal. Estimated cost, \$100,000.

ST. LOUIS—Poro College, 4316 St. Ferdinand St., has awarded the contract for the construction of a 3-story, 46 x 125-ft. college at 4300 St. Ferdinand St., to T. H. Ratz, 917 Pine St. Laboratory equipment will be needed. Estimated cost, \$40,000.

ST. LOUIS—The Monsanto Chemical Works, 1800 South 2nd St., are building a 1-story, 66 x 141-ft. chemical factory at 1823-27 Kosciusko St. Estimated cost, \$16,000.

ST. LOUIS—The St. Louis Metalware Co., 2503 North Broadway, has awarded the contract for the construction of a 2-story, 220 x 360-ft. factory, at 5735-37 Natural Bridge Rd., to the Gamble Construction Co., 620 Chestnut St. Estimated cost, \$66,000.

Nebraska

OMAHA—Farrell & Co., 10th and Dodge Sts., has awarded the contract for the construction of a 6-story, 60 x 106-ft. syrup and can manufacturing plant on the northwest corner of 9th and Dodge Sts., to Peter Kiewit & Sons, 754-56 Omaha National Bank Bldg. Estimated cost, \$200,000.

New Jersey

BAYONNE—The White Oil Corporation, 501 Fifth Ave., New York City, has purchased a 16-acre site along the waterfront, here, and plans to construct a modern distributing station for domestic and export business. Plans include five 75,000-bbl. tanks, fourteen 10,000-bbl. tanks, a canning plant and other buildings. Estimated cost, \$114,000,000.

JERSEY CITY—The Baker Castor Oil Co., Morgan St., plans to build a 1-story tile building to be used as a laboratory. Estimated cost, \$10,000.

JERSEY CITY—The Colgate Co., 105 Hudson St., manufacturer of soaps, has awarded the contract for the construction of an addition to its factory on York St., to the Turner Construction Co., 242 Madison Ave., New York City. Estimated cost, \$200,000.

TRENTON—The Maddock Pottery Co., 3rd St., plans to build a pottery plant, to include a 60 x 160-ft. kiln building, 2-story, 50 x 120-ft. plant and a 3-story, 60 x 120-ft. plant. Estimated cost, \$150,000. J. O. Hunt, 114 North Montgomery St., architect.

New York

ALBANY—The Albany Chemical Co., 2-24 Broadway, has awarded the contract for the construction of a 3-story, 57 x 59-ft. building, on Tuay and Gansevoort Sts., to F. J. Stevens, 85 Morris St. Estimated cost, \$53,000.

BOLIVAR—L. G. Burt, Bradford, Pa., plans to erect a refinery here.

BROOKLYN—The C. W. H. Carter Co. is having preliminary plans prepared for altering building on Columbia, Sigourney and Bay Sts., and construction drum building, addition to same. Estimated cost, \$100,000. McCarthy & Kelly, 16 Court St., engineer.

BUFFALO—The Buffalo Porcelain Enameling Co. has awarded the contract for the construction of a 1-story, 60 x 140-ft. enameling plant, to the Crescent Concrete Co., Erie County Bank Bldg. Estimated cost, \$35,000.

LONG ISLAND CITY—The Pathe Exchange, Inc., 25 West 45th St., New York City, plans to build a 200 x 400-ft. laboratory on Anby St. Estimated cost, \$500,000.

NEW YORK—The Vitreous Enameling & Stamping Co., Inc., 11 East 167th St., (Bronx Boro) is having plans prepared for the construction of a 1-story, 70 x 172-ft. factory and garage on Sedgwick Ave. and 171st St. Estimated cost, \$80,000. W. J.

Flinn, president, F. W. Rinn, 70 West 181st St., architect and engineer.

NIAGARA FALLS—The Carborundum Co., Buffalo Ave. and 14th St., has awarded the contract for the construction of a 2-story, 64 x 96-ft. factory addition on Buffalo Ave., to the Kearns Construction Co., Boston, Mass. Estimated cost, \$40,000.

OGDENSBURG—The Morgan Chemical Co. has taken over the plant of the Arnold Brewing Co. and will alter and build addition to same for its own use. Estimated cost, \$60,000. N. E. Morgan, Hermon, president.

North Carolina

CHARLOTTE—J. F. Harrison, Greensboro, has awarded the contract for the construction of a 62 x 125-ft. carbonic acid gas factory, to J. A. Gardner, Charlotte. Estimated cost, \$15,000.

GASTONIA—The city plans to extend sewerage and water systems and build a disposal plant. Estimated cost, \$100,000. W. M. Pratt, Durham, engineer.

ROCKY MOUNT—The Faison Brick Co., plans to build a brick plant. Estimated cost, \$60,000. Work will be done by day labor.

North Dakota

MINOT—The city is having plans prepared for the construction of a sewerage system and a disposal plant. Estimated cost, \$285,000. Frederick H. Bass, 515 Southeast 6th St., Minneapolis, Minn., engineer. Noted Oct. 15.

Ohio

AKRON—The Star Rubber Co., 1068 Sweitzer Ave., is having plans prepared for the construction of a 4-story, 60 x 110-ft. rubber factory on Sweitzer Ave. Estimated cost, \$75,000. Osborn Engineering Co., 2848 Prospect Ave., Cleveland, engineer.

CINCINNATI—The Rapid Electrotpe, Canal St. near Race St., plans to build a 2-story, 100 x 215-ft. factory on McMicken and Elm Sts. Zettell & Rapp, Mercantile Bldg., architects.

CLEVELAND—The Hydraulic Press Steel Co. has awarded the contract for the construction of a 1-story, 75 x 200-ft. factory addition on Hydraulic Ave., to the Craig-Curtiss Co., 1031 Guardian Bldg. Estimated cost, \$100,000.

GRAFTON—The village is having preliminary surveys made for the construction of a sewage disposal plant and waterworks. Estimated cost, \$100,000. R. Knight, city clerk. R. W. Pratt, Hippodrome Bldg., Cleveland, engineer.

TOLEDO—The Standard Oil Co. of Ohio, East Ohio Gas Bldg., Cleveland, is in the market for \$75,000 worth of equipment for maintenance of its refineries here, and will require shears, milling machines, radial drills and similar equipment.

CLEVELAND—The Citizens Savings & Trust Co., Citizens Bldg., is having plans prepared for the construction of a 20-story, 258 x 383-ft. bank and office building on Euclid Ave. and East 9th St. A complete water purification and refrigerator plant will be installed in same. Estimated cost, \$3,000,000. Graham, Probst, Anderson & White, Railway Exchange Bldg., Chicago, architects and engineers.

CLEVELAND—The city is having preliminary plans prepared for the construction of a 160,000,000-gal. filtration plant. Estimated cost, \$5,000,000. Robert Hoffman, 618 City Hall, city engineer.

CLEVELAND—The Manufacturers Oil & Grease Co., Century Bldg., has awarded the contract for the construction of a 2-story, 78 x 83-ft. factory, to the Watson Engineering Co., 1101 Hippodrome Bldg. Estimated cost, \$75,000.

CLEVELAND—The Mechanical Rubber Co. has awarded the contract for the construction of a 5-story, 80 x 200-ft. factory on Lisbon Rd., to Stone & Webster Co., 120 Broadway, New York City. Estimated cost, \$250,000.

CLEVELAND—The Monarch Brass Co., 4113 Payne Ave., has awarded the contract for the construction of a 2-story, 60 x 200-ft. factory on 45th St. and Payne Ave., to the Emerson Co., 1900 Euclid Bldg. Estimated cost, \$150,000.

ELYRIA—The city will receive bids in December for the construction of a complete waterworks system, including a filter house, etc. Estimated cost, \$1,000,000. Morris Knowles, Jones Law Bldg., Pittsburgh, Pa., engineer.

KENMORE—The city will receive bids

after Jan. 1 for the construction of a sewage disposal plant, sedimentation tanks and basins. Estimated cost, \$80,000. L. W. Baughman, service director. R. W. Pratt, Hippodrome Bldg., Cleveland, engineer.

WILLOUGHBY—The Zenith Tire & Rubber Co., 456 Leader-News Bldg., Cleveland, is having plans prepared for the construction of a 3-story, 100 x 585-ft. rubber factory and power house. Estimated cost, \$500,000. A. W. Harris, 829 Schofield Bldg., Cleveland, architect and engineer.

Oklahoma

CLEVELAND—The city, c/o Davis B. Heller, voted \$40,000 bonds for the construction of a gas plant and pipe line system.

EL RENO—The city has awarded the contract for the construction of a disposal and treatment plant, and the extension of the sanitary sewerage system, to Tibbets & Pleasant, 204 Daniel Bldg., Tulsa. Estimated cost, \$91,002. Noted Aug. 15.

HOMINY—The city plans to construct a filtration plant in connection with the proposed water system. C. E. Lee, city engineer, preparing plans.

TULSA—The city plans to build a sewage disposal plant with capacity sufficient to take care of entire city. Estimated cost, \$250,000. C. E. Griggs, City Hall, city engineer.

Oregon

BEND—The Portland Cement Pipe Co., 410 River St., Portland, is having preliminary plans prepared for the construction of plant for the manufacture of cement pipe to be used in highway construction. Estimated cost, \$10,000. C. H. Bullen, 410 River St., manager.

LINNTON—The Associated Oil Co., Pittock Bldg., Portland, has awarded the contract for the construction of an oil plant, including a septic tank, sewerage system, etc., to the Dinwiddie Construction Co., Yeon Bldg., Portland. Estimated cost, \$120,000.

Pennsylvania

ELLWOOD—The city plans to construct a sewage plant. C. C. Hall, city clerk. R. W. Pratt, Hippodrome Bldg., Cleveland, engineer. Noted May 1.

MINERS MILLS (Wilkes-Barre P. O.)—The Miner-Hillard Milling Co., Wyoming National Bank Bldg., Wilkes-Barre, plans to build 2-story, 40 x 80-ft. laboratories on Main St. Estimated cost, \$50,000.

NEW BRIGHTON—The city will receive bids next spring for the construction of a sewage disposal plant. F. R. O'Rourke, city clerk. R. W. Pratt, Hippodrome Bldg., Cleveland, Ohio, engineer.

STEELTON—The Bethlehem Steel Co. will build a 3-story, 61 x 114-ft. laboratory. Bissell & Sinbler, Otis Bldg., 16th and Sansom Sts., architects.

Rhode Island

PROVIDENCE—George F. Berkander, 43 Sabin St., has awarded the contract for the construction of a 2-story, 83 x 204-ft. factory, for the manufacture of celluloid novelties, on Broad St., to F. G. Rowley Co., 260 Central Ave., Pawtucket. Estimated cost, \$100,000.

Tennessee

MEMPHIS—The Seven States Oil Co. plans to construct a modern crude oil refinery, here, to have a capacity of 2000 bbl. per day. Estimated cost, \$175,000. Address W. T. Berlin, chairman.

Texas

DUBLIN—The Pullman Oil & Refining Co., Ft. Worth, plans to construct a 1-story, 3500-bbl. refinery here. Site is about 20 miles from the Desdemona Field. Estimated cost, \$300,000.

FT. WORTH—The Invader Oil & Refining Co., Texas State Bank Bldg., will receive bids until Dec. 10 for the construction of a 1 and 2-story refinery on a 70-acre tract, here. Estimated cost, \$700,000. Address: Owen A. Wood, c/o Invader Oil & Refining Co.

HOUSTON—The Mack Manufacturing Co., Ltd., 821 Kress Bldg., has awarded the contract for the construction of six 1 and 3-story buildings, to the W. C. Hedrick Contracting Co., Houston. Buildings in-

clude foundry forge shops, pattern shops, offices and warehouses. Charles R. Edwards, superintendent of plant.

JACKSBORO—The Texas United Oil & Refining Co., Ft. Worth, plans to construct a 1-story refinery, here. Estimated cost, \$350,000.

TEXAS—Several officials of the White Oil Corporation, 501 5th Ave., New York City, are inspecting sites along the Texas coasts with a view to constructing a 15,000-bbl. refinery. Definite location not yet decided upon. Estimated cost, \$500,000. T. J. White, president. Engineer not yet selected.

Virginia

ORANGE—The city is having plans prepared for the installation of a filtration plant and water system. Estimated cost, \$70,000. Address A. J. Harlow, mayor, Saville & Claiborne, 7th and Main Sts., Richmond, engineers.

Wisconsin

CUDAHY—The Federal Rubber Co. has awarded the contract for the construction of a 2-story, 50 x 100-ft. rubber cement house, to the T. Siderits Construction Co., 1574 2nd St., Milwaukee. Estimated cost, \$60,000.

KEWASHUM—Leigh Hunt, architect and engineer, 501 Security Bldg., Milwaukee, will soon award the contract for the construction of a 2-story, 50 x 180 ft. factory, for the Kewashum Aluminum Co. Estimated cost, \$50,000.

MADISON—The Burgess Battery Co. plans to construct a 3-story, 165 x 235-ft. building consisting of offices, laboratories and housing for the plant equipment.

MILWAUKEE—The Great Lakes Mal-leable Co., 710 Reed St., has awarded the contract for the construction of a 1-story, 60 x 77-ft. annealing plant on Reed St., to John T. Stanage, 144 Oneida St. Estimated cost, \$10,000.

RACINE—The J. I. Case Threshing Machine Co. has awarded the contract for the construction of a 1-story, 130 x 130-ft. testing building, to Nelson & Co., Robinson Bldg. Estimated cost, \$100,000.

SOUTH MILWAUKEE—The Universal Aniline Dyes & Chemical Co., 1009 Wells Bldg., plans to construct a 1, 2 and 3-story dye manufacturing plant, including a 1-story, 30 x 40-ft. laboratory, power house, main building, 2 or 3 dye houses, warehouse, office, etc. Estimated cost, \$200,000. O. C. Vehling, 511 First National Bank Bldg., Milwaukee, architect and engineer.

WEST BEND—The West Bend Aluminum Co. plans to build a 4-story, 70 x 190-ft. factory addition. Estimated cost, \$100,000. Federal Engineering Co., Stephenson Bldg., Milwaukee, architect and engineer.

Wyoming

CHEYENNE—A. A. Boernsen, architect, Cheyenne, will receive bids this year for the construction of a 4-story, 200 x 200-ft. hospital on 23rd and House Sts., for Laramie County. An apparatus and laboratory equipment will be installed in same. Estimated cost, \$300,000.

MOORCROFT—The U. S. Oil Refining & Gas Co. plans to construct a 1-story oil refinery, here. Estimated cost, \$250,000.

British Columbia

ROSSLAND—The Consolidated Mining & Smelting Co. of Canada plans to construct a steel mine concentrator, having a daily capacity of 15,000 tons. Estimated cost, \$1,000,000.

Ontario

BOSTON CREEK—The Miller Independent Mines, Ltd., plans to install a new electrical plant and mill, at its gold mine here. C. A. Miller, superintendent.

BRANTFORD—The Water Commission has had preliminary plans prepared for the construction of a filtration plant and capacity about 3,000,000 gallons. Estimated cost, \$500,000 to \$600,000. T. Harry Jones, City Hall, city engineer. R. S. and W. S. Lea, New Birks Bldg., Montreal, consulting engineers.

GODERICK—The Lake Huron Steel Corporation plans to construct a complete new 1-story steel plant, including a blowing mill for manufacturing steel billets, rods and steel for the automobile trade, and high grade steel products. Six Herouet electric furnaces will be installed in same.

Estimated cost between \$6,000,000 and \$10,000,000. Edward H. Beck, chief engineer.

NEW TORONTO—The Canadian Photo Plays, Ltd., Kent Bldg., Toronto, has awarded the contract for the construction of a 3-story, 80 x 150-ft. moving picture studio on Hamilton Highway, to the Dunbar Engineering Co., Kent Bldg. A complete dark room and photographic equipment will be installed in same. Estimated cost, \$150,000.

PETERBOROUGH—The city had plans prepared for the construction of a sewage disposal plant, consisting of a 2-story sedimentation tank, sprinkling filters and humus tanks. From the humus tanks the effluent will be discharged into the Ostanabee River. Estimated cost, \$125,000. R. H. Parsons, city engineer.

PETERBOROUGH—The Board of Education has awarded the contract for the construction of a 3-story building to be used as a collegiate institute, to include a chemical and physical laboratory, to Graham & Hayes, Peterborough, \$159,963. Estimated cost, \$250,000.

WINDSOR—A. H. McPhail, architect, will soon award the contract for the construction of a 3-story high school for the Board of Education. Chemical and physical laboratory equipment will be installed in same. Estimated cost, \$450,000.

Quebec

MONTREAL—The Lignite Utilization Board of Canada, 80 St. Francois St., will receive bids until Dec. 14 for furnishing briquetting machinery.

New Publications

A REPORT OF THE ACTIVITIES OF THE WAR DEPARTMENT IN THE FIELD OF INDUSTRIAL RELATIONS DURING THE WAR. A bulletin published by the War Department, Sept. 15, 1919.

A RESTUDY OF THE STAUNTON GAS POOL. By L. A. Lyllis. Extract from Bull. No. 44, State Geological Survey, Urbana, Ill.

THE OIL SHALES OF NORTHWESTERN COLORADO. Bull. No. 8, Aug. 1, 1919, published by the State of Colorado, Bureau of Mines, Denver, Colo.

"ASBESTOS" is the title of a new monthly magazine published in the interests of the asbestos and magnesite industry. The first issues appeared in July and each month since it has gone to its subscribers on the 15th. It is published by the Secretarial Service, 721 Bulletin Bldg., Philadelphia, Pa.

U. S. FUEL ADMINISTRATION, Oil Division bulletin—Prices of Petroleum and Its Products During the War. By Joseph E. Pogue and Isador Lubin.

COLORADO SCHOOL OF MINES QUARTERLY, dated October, 1919, issued by the Colorado School of Mines, Golden, Colo.

WAR INDUSTRIES BOARD PRICE BULLETINS: No. 1, History of Prices During the War, by Wesley C. Mitchell; No. 4, Prices of Foods, by Murray S. Wildman; No. 5, Prices of Clothing, by John M. Curran; No. 6, Prices of Building Materials, by Homer Hoyt; No. 23, Prices of Cotton and Cotton Products, by James Harvey Rogers, assisted by Grace M. Fairchild and Florence A. Dickinson; No. 24, Prices of Wool and Wool Products, by Katherine Snodgrass; No. 25, Prices of Silk and Silk Products, by Oscar B. Ryder; No. 26, Prices of Hides and Skins and Their Products, by A. E. James, assisted by L. B. Kagan; No. 30, Prices of Rubber and Rubber Products, by Isador Lubin; No. 33, Prices of Iron, Steel, and Their Products, by Walter W. Stewart; No. 34, Prices of Ferro-Alloys, Non-Ferrous and Rare Metals, by H. R. Aldrich and Jacob Schmuckler; No. 44, Prices of Paints and Varnishes, by Arthur Minnick; No. 48, Prices of Fertilizers, by H. L. Trumbull; No. 49, Prices of Soaps and Glycerine, by H. L. Trumbull; No. 51, Prices of Wood Distillation Products and Naval Stores, by P. W. Carleton; No. 52, Prices of Natural Dyestuffs and Tanning Chemicals, by P. W. Carleton; No. 56, Prices of Explosives, by C. L. Fry; No. 57, Prices of Miscellaneous Organic Chemicals, by Arthur Minnick.

NEW BUREAU OF STANDARDS PUBLICATIONS: Circ. No. 80, Protective Metallic Coatings for the Rustproofing of Iron and Steel, issued Oct. 4, 1919; Scien. Paper No. 340, A Standardized Method for the Determination of Solidification Points, Especially of Naphthalene and Paraffine, by R. M. Wilhelm and J. L. Finkelstein, issued Sept. 12, 1919; Scien. Paper No. 342, Reflecting Power of Stellite and Lacquered

Silver, by W. W. Coblenz and H. Kahler, issued Sept. 11, 1919; Scien. Paper No. 343, Location of Flaws in Rifle-Barrel Steel by Magnetic Analysis, by R. L. Sanford and Wm. B. Kouwenhoven, issued Oct. 3, 1919; Scien. Paper No. 348, Use of a Modified Rosenhain Furnace for Thermal Analysis, by H. Scott and J. R. Freeman, Jr., issued Oct. 24, 1919; Scien. Paper No. 349, Photoelectric Spectrophotometry by the Null Method, by K. S. Gibson, issued Oct. 11, 1919; Tech. Paper No. 18, Electrolysis in Concrete, by E. B. Rosa, Burton McCollum and O. S. Peysers, 2nd ed., issued Aug. 1, 1919; Tech. Paper No. 131, Application of the Interferometer to Gas Analysis, by Junius David Edwards, issued Oct. 6, 1919; Tech. Paper No. 132, Mechanical Properties and Resistance to Corrosion of Rolled Light Alloys of Aluminum and Magnesium With Copper, With Nickel, and With Manganese, by P. D. Merica, R. G. Waltenberg and A. N. Finn, issued Oct. 25, 1919; Tech. Paper No. 133, Tests of Flexible Gas Tubing, by R. S. McBride and Walter M. Berry, issued Oct. 27, 1919; Tech. Paper No. 134, Experimental-Retort Tests of Orient Coal, by R. S. McBride and I. V. Brumbaugh, issued Sept. 26, 1919; Tech. Paper No. 135, Behavior of Wrought Manganese Bronze Exposed to Corrosion While Under Tensile Stress, by P. D. Merica and R. W. Woodward, issued Oct. 16, 1919; Tech. Paper No. 139, Some Tests of Light Aluminum Casting Alloys—the Effect of Heat Treatment, by P. D. Merica and C. P. Karr, issued Oct. 24, 1919; Tech. Paper No. 140, Constant-Temperature Still Head for Light-Oil Fractionation, by Frederick M. Washburn, issued Oct. 18, 1919.

NEW BUREAU OF MINES PUBLICATIONS: Bull. 178-B, War Minerals, Nitrogen Fixation and Production of Sodium Cyanide, by Van H. Manning; Bull. 178-D, Explosives and Miscellaneous Investigations; Tech. Paper 210, An Analytical Method for Detecting Blown-Out Shots in Coal-Mines, by G. F. Hutchison and Jacob Barab; Tech. Paper 220, Burning Steam Sizes of Anthracite With or Without Admixture of Soft Coal, by U. S. Fuel Administration; Tech. Paper 222, Method of Administering Leases of Iron-Ore Deposits Belonging to the State of Minnesota, by J. R. Finlay; Tech. Paper 225, The Vapor Pressure of Lead Chloride, by E. D. Eastman and L. H. Duschak; Tech. Paper 226, Men Who Received Bureau of Mines Certificates of Mine-Rescue Training July 1, 1916 to June 30, 1918, Compiled by Dorsey J. Parker; Tech. Paper 231, Production of Explosives in the United States During the Calendar Year 1918, with notes on coal-mine accidents due to explosives and list of permissible explosives tested prior to March 31, 1919, compiled by Albert H. Fay; Tech. Paper 239, Coke-Oven Accidents in the United States During the Calendar Year 1918, compiled by Albert H. Fay; Tech. Paper 242, Why and How Coke Should Be Used for Domestic Heating, by Henry Kreislinger and A. C. Fieldner; Tale Mining in Vermont, by Raymond B. Ladoo, mineral technologist.

NEW U. S. GEOLOGICAL SURVEY PUBLICATIONS: I:3 Tin in 1918, by Adolph Knopf (Mineral Resources of the U. S., 1918, Part I), published Sept. 9, 1919; I:4 Antimony in 1918, by Henry G. Ferguson (Mineral Resources of the U. S., 1918, Part I), published Oct. 18, 1919; II:4, Prices of Coal and Coke 1913-1918, by C. E. Leshner (Mineral Resources of the U. S., 1918, Part II), published Aug. 29, 1919; II:5, Salt, Bromine, and Calcium Chloride in 1918, by Ralph W. Stone (Mineral Resources of the U. S., 1918, Part II), published Aug. 16, 1919; II:6, Fuller's Earth in 1918, by Jefferson Middleton (Mineral Resources of the U. S., 1918, Part II), published Aug. 27, 1919; II:7, Magnesite in 1918, by Charles G. Yale and Ralph W. Stone (Mineral Resources of the U. S., 1918, Part II), published Sept. 16, 1919; II:8, Sodium and Sodium Compounds in 1918, by Roger C. Wells (Mineral Resources of the U. S., 1918, Part II), published Oct. 24, 1919; II:9, Phosphate Rock in 1918, by Ralph W. Stone (Mineral Resources of the U. S., 1918, Part II), published Oct. 4, 1919; II:10, Graphite in 1918, by Henry G. Ferguson (Mineral Resources of the U. S., 1918, Part II), published Oct. 20, 1919; II:11, Slate in 1918, by G. F. Loughlin and A. T. Coons (Mineral Resources of the U. S., 1918, Part II), published Oct. 23, 1919; II:32, Coal in 1917; Part A, Production, by C. E. Leshner (Mineral Resources of the U. S., 1917, Part II), published Sept. 26, 1919; II:33, Natural Gas and Natural-Gas Gasoline in 1917, by John D. Northrop (Mineral Resources of the U. S., 1917, Part II), published Sept. 20, 1919; II:34, Coke and By Products in 1916 and 1917, by C. E. Leshner and W. T. Thom, Jr. (Mineral Resources of the U. S., 1917, Part II), published Sept. 19, 1919; Preliminary Report of the Mineral Resources of the U. S. in 1918, published Aug. 7, 1919.

Supplement

Readers have doubtless noted the line in bold type appearing across the top of front cover, contents and first text page: "Published December 8th, With Current News." "Current News" can mean but one thing, and involves printing in each issue market reports compiled near the actual date of issue, rather than the serial date appearing in the running heads, which must be consecutive, according to postal regulations. Therefore, for statistical record, are assembled here the five weekly market reports and price lists intervening between that published in the issue of Oct. 22, mailed from Cooperstown, and this combined issue (Oct. 29-Nov. 5) mailed from New York. Market news now and hereafter is of the latest date consistent with proper printing and accuracy.

Current Market Reports

The Non-Ferrous Metal Market

Saturday, Oct. 25.—Export sales have not developed.

Aluminum:—Transactions are mainly by direct contract. The open market continues quiet; 98-99 per cent ingots are quoted at 33c. per lb; cast scrap, 25-25½c.; sheet scrap, 23½-24c.; clippings, 27-28c.

Antimony:—The market is firm with no change in prices.

Copper:—Comparatively speaking, there are no transactions in copper taking place at present.

	Cents per Lb.
Copper, lake, spot.....	22.75 — 23.50
Copper, electrolytic, spot.....	21.25 — 22.50
Copper, casting, spot.....	21.00 — 21.50
Copper sheets, hot-rolled.....	32.50 —
Copper sheets, cold rolled.....	34.00 —
Copper bottoms.....	40.50 —
Copper rods.....	24.50 —
Copper wire.....	26.00 —
High brass wire and sheets.....	27.75 —
High brass rods.....	25.75 —
Low brass wire and sheets.....	29.50 —
Low brass rods.....	30.25 —
Brased brass tubing.....	38.00 —
Brased bronze tubing.....	43.25 —
Seamless copper tubing.....	35.50 —
Seamless bronze tubing.....	40.00 —
Seamless brass tubing.....	34.00 —
Scrap, heavy machinery comp.....	18.00 — 18.50
Scrap, heavy and wire.....	17.50 — 17.75
Scrap, light and bottoms.....	15.00 — 16.00
Scrap, heavy, cut and crucible.....	19.00 — 19.75
Scrap brass, casting.....	10.25 — 10.75
Scrap brass, light.....	12.00 — 12.50
Scrap, No. 1 clean brass turnings.....	9.00 — 9.75
Scrap, No. 1 comp. turnings.....	15.75 — 16.00

Lead:—The price of lead has been steadily advancing and is quoted at 6.75-6.80c. New York, and 6.50c. East St. Louis.

Tin:—Due to the longshoremen's strike, tin is being quoted at 54.5c. lb. on shipboard, 55c. on docks and 56½c. from stock.

Zinc:—Similarly to the lead market, zinc has steadily advanced and is quoted at 7.75c. at East St. Louis and 7.80c. lb. at New York.

OTHER METALS

Bismuth.....	lb.	\$2.95 —
Cadmium.....	lb.	1.50 — 1.75
Cobalt.....	lb.	2.50 — 3.50
Magnesium.....	lb.	1.75 — 2.10
Mercury.....	75 lb.	95.00 —
Nickel.....	lb.	.41 — .45
Iridium.....	oz.	175.00 —
Palladium.....	oz.	115.00 — 120.00
Platinum.....	oz.	130.00 — 135.00
Silver.....	oz.	1.194 —

The Iron and Steel Market

In terms of tonnage output now when the strike is entering its sixth week, production is at about 60 per cent of normal.

President Wilson's industrial or labor conference at Washington convened when the strike was two weeks old. It was being kept going, as well as it could be, in hope of there being interference from Washington, the strike having no chance of gaining anything by its own effort. The Senate Committee on Education and Labor investigated the strike and developed no sympathy whatever for it, and there remained the Labor Conference, which disbanded on Oct. 24.

The sharpest gain made in the past fortnight has been by the Lackawanna Steel Co. in the Buffalo district, which was closed entirely at the outset, but is now operating moderately well. The Mahoning Valley was closed entirely until late in the third week, when one or two blast-furnaces in Youngstown resumed, but even at the end of the fifth week the Valley was doing but little, its tonnage output not being over 15 or 20 per cent of normal. Such operations as are conducted are largely by men living within the mills.

Western Pennsylvania is now producing at nearly if not quite 90 per cent of normal. Small portions of the Pittsburgh district lie outside the county, including Donora and Monessen, up the Monongahela River, which were closed entirely and are now doing rather poorly, and Woodlawn, down the Ohio, which has operated practically normal throughout the strike.

There is a little operation in Cleveland, while the Wheeling district remains tightly closed. Gary and Chicago are doing somewhat better each week, but still very poorly.

At this writing the impending coal strike, set for Nov. 1, is a more serious matter to the iron and steel industry than its own strike. The mills have little coal in stock and could not have stocked much even if they had had an ample supply of labor. While the Connellsville coke region has hitherto been strictly non-union, the balance of probability seems to be that it would be seriously crippled eventually if the union coal miners should all strike.

Many of the steel mills are selling in more or less reserved manner to their regular customers, but chance buyers of steel can obtain practically nothing. The majority of manufacturing consumers are probably out of stock by this time and are presumably curtailing their operations somewhat, but little is heard of these troubles, for all buyers of steel are in strong sympathy with the mills, therefore do not complain.

The curtailment in steel production, following a condition of normal production being fully and eagerly absorbed at regular prices, the March 21 schedule, would easily cause prices to advance if the market were left to itself, but large conservative interests, including in particular the Steel Corporation, are practically certain to oppose price advances, at least during and immediately after the strike, if not for a long time afterward. A delivery premium market is likely to obtain, with regular prices done on deliveries at mill convenience.

The Chemical Market

New York, October 25, 1919.

The dock strike continues to be the potent factor influencing market conditions in New York. Among heavy chemicals interest has been focused on spot goods due to the difficulty in getting shipments on contracts. The past week has brought no change of conditions in the coal-tar market. While some spot supplies are to be found, they are of the less commonly used materials. Vegetable oils and naval stores have displayed opposite tendencies, the former upward, the latter weak and declining in price.

HEAVY CHEMICALS

Caustic soda and *soda ash* were the leaders, the bulk of the demand for the former being for export. Although English manufacturers of caustic soda are quoting under the American market, they are unable to make prompt deliveries. Japan, South America and Mexico are therefore turning to the United States. Three dollars and thirty-two cents per cwt. was probably the best that could be done for spot material, while most quotations ranged from \$3.40 to \$3.50. Supplies of soda ash in second hands are so limited that quotations are practically uniform, business depending mostly on the brand offered. One lot of 300 tons was sold at \$1.85 per cwt., but the price is now held at \$2.15 f.o.b. New York.

Only one or two dealers are holders of spot *formaldehyde*, and their price runs 25-27½c. per lb. Manufacturers' price for delivery next month is 24c.

The fact that one important manufacturer has stopped making *carbon bisulphide* means that none is to be had for prompt delivery.

There are a few weak holders of *sodium prussiate, yellow*, which condition is the main factor in keeping the market down to 24½c. per lb.

Although the quotation on *denatured alcohol* remains unaltered, it is nominal because of paucity of stocks.

VEGETABLE OILS

Owing to quotations from the Orient being higher and the fact that oils cannot be replaced at the figures which have been prevailing, the market displays an upward tendency. Coconut and soya bean oils have been in the greatest demand, while interest in chinawood oil has greatly decreased due to paint and varnish manufacturers being well stocked. Coconut oil owes its strong position to recent lack of importation, and soya bean to recent buying by soap manufacturers.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, OCT. 25, 1919

	Carlots	Less Carlots
Acetic anhydride.....lb.	\$0.55	\$0.60
Acetone.....lb.	\$0.131	\$0.14
Acid, acetic, 28 per cent.....cwt.	2.50	3.00
Acetic, 56 per cent.....cwt.	5.00	5.50
Acetic, glacial, 99 1/2 per cent, carboys.....cwt.	12.00	12.50
Boric, crystals.....lb.	.13	.13 1/2
Boric, powder.....lb.	.13	.13 1/2
Hydrochloric, (muriatic) tech. 20 deg.....cwt.	1.50	1.75
Hydrofluoric, 52 deg.....lb.	.12	.14
Lactic, 44 per cent. tech.....lb.	.11	.14
Lactic, 22 per cent. tech.....lb.	.05	.06
Molybdc, C. P.....lb.	4.00	4.25
Nitric, 40 deg.....lb.	.06	.06 1/2
Nitric, 42 deg.....lb.	.07	.07 1/2
Oxalic, crystals.....lb.	.23	.25
Phosphoric, Ortho, 50 per cent. solution.....lb.	.09	.10
Picric.....lb.	.30	.35
Pyrogallol, resublimed.....lb.	2.30	2.60
Sulphuric, 60 deg., tank cars.....ton	12.00	16.00
Sulphuric, 60 deg., drums.....ton	17.00	22.00
Sulphuric, 60 deg., carboys.....ton	20.00	25.00
Sulphuric, 66 deg., tank cars.....ton	17.00	18.00
Sulphuric, 66 deg., drums.....ton	20.00	21.00
Sulphuric, 66 deg., carboys.....ton	25.00	30.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars.....ton	20.00	26.00
Sulphuric, fuming, 20 per cent. (oleum) drums.....ton	25.00	32.00
Sulphuric, fuming, 20 per cent. (oleum) carboys.....ton	30.00	35.00
Tannic, U. S. P.....lb.	1.35	1.45
Tannic (tech.).....lb.	.42	.55
Tartaric, crystals.....lb.	.73	.74
Tungstic, per lb. of WO.....lb.	1.20	1.40
Alcohol, Ethyl.....gal.	4.80	4.95
Alcohol, Methyl.....gal.	1.30	1.33
Alcohol, denatured, 188 proof.....gal.	.56	.58
Alcohol, denatured, 190 proof.....gal.	.52	.54
Alum, ammonia lump.....lb.	.03 1/2	.04 1/2
Alum, potash lump.....lb.	.08	.08 1/2
Alum, chrome lump.....lb.	.15	.16
Aluminum sulphate, commercial.....lb.	.01 1/2	.02
Aluminum sulphate, iron free.....lb.	.02 1/2	.03
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	.08	.08 1/2
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.	.13	.13 1/2
Ammonium carbonate, powder.....lb.	.13	.14
Ammonium chloride, granular (white salamoniac).....lb.	.12 1/2	.13
Ammonium chloride, granular (gray salamoniac).....lb.	.12	.12 1/2
Ammonium nitrate.....lb.	.10	.11
Ammonium sulphate.....lb.	.05	.06
Amyl acetate.....gal.	3.65	3.75
Arsenic, oxide, lumps (white arsenic).....lb.	.09	.09 1/2
Arsenic, sulphide, powdered (red arsenic).....lb.	85.00	90.00
Barium chloride.....ton	22	24
Barium dioxide (peroxide).....lb.	.09 1/2	.10 1/2
Barium nitrate.....lb.	.03	.03 1/2
Barium sulphate (precip.) (blanc fixe).....lb.	.03	.03 1/2
Bleaching powder (see calcium hypochlorite).....lb.	19.00	25.00
Blue Vitriol (see copper sulphate).....lb.	.01 1/2	.01 1/2
Borax (see sodium borate).....lb.	2.25	2.50
Bromine.....lb.	.65	.75
Calcium acetate.....cwt.	2.00	2.05
Calcium carbide.....lb.	.04 1/2	.05
Calcium chloride, fused, lump.....ton	30.00	40.00
Calcium chloride, granulated.....lb.	.02	.02 1/2
Calcium hypochlorite (bleaching powder).....cwt.	2.25	2.50
Calcium hypochlorite (bleaching powder).....lb.	1.50	1.70
Calcium phosphate, monobasic.....lb.	.75	.75
Calcium sulphate, precipitated.....lb.	.09	.09 1/2
Carbon bisulphide.....lb.	.05 1/2	.06
Carbon tetrachloride, drums.....lb.	.12	.14
Carbonyl chloride (phosgene).....lb.	.75	.75
Caustic potash (see potassium hydroxide).....lb.	.05	.05 1/2
Caustic soda (see sodium hydroxide).....lb.	.05	.05 1/2
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	.05	.05 1/2
Cobalt oxide.....lb.	1.50	1.55
Copperas (see iron sulphate).....lb.	.28	.31
Copper carbonate, green precipitate.....lb.	.65	.70
Copper cyanide.....lb.	.09	.09 1/2
Copper sulphate, crystals.....lb.	.08 1/2	.08 1/2
Cream of tartar (see potassium bitartrate).....lb.	.23 1/2	.26
Epsom salt (see magnesium sulphate).....lb.	.19	.21
Formaldehyde, 40 per cent.....lb.	.45	.50
Glauber's salt (see sodium sulphate).....lb.	.19	.21
Glycerine.....lb.	4.50	5.00
Iodine, resublimed.....lb.	.03	.03
Iron oxide, red.....lb.	1.20	1.50
Iron sulphate, (copperas).....cwt.	1.20	1.50
Lead acetate, normal.....lb.	.12 1/2	.14 1/2
Lead arsenate (paste).....lb.	.13	.17
Lead nitrate, crystals.....lb.	.85	.86 1/2
Litharge.....lb.	.09 1/2	.10 1/2
Lithium Carbonate.....lb.	.50	.50
Magnesium carbonate, technical.....lb.	.13	.14 1/2
Magnesium sulphate, U. S. P.....100 lb.	2.00	2.63
Magnesium sulphate, commercial.....100 lb.	1.75	2.00
Nickel salt, double.....lb.	.14	.15
Nickel salt, single.....lb.	.12	.16
Phosgene (see carbonyl chloride).....lb.	.60	.70
Phosphorus, red.....lb.	.35	.37
Phosphorus, yellow.....lb.	.26	.27
Potassium bichromate.....lb.	.55	.60
Potassium bitartrate (cream of Tartar).....lb.	.50	.65
Potassium bromide, granular.....lb.	.60	.70
Potassium carbonate, U. S. P.....lb.	.25	.26
Potassium carbonate, crude.....lb.	.19	.20
Potassium chlorate, crystals.....lb.	.30	.32
Potassium cyanide, 98-99 per cent.....lb.	nominal	3.55
Potassium hydroxide (caustic potash).....lb.	.30	.32
Potassium iodide.....lb.	3.55	3.60
Potassium nitrate.....lb.	.19	.21
Potassium permanganate.....lb.	.55	.65
Potassium prussiate, red.....lb.	1.05	1.15

	Carlots	Less Carlots
Potassium prussiate, yellow.....lb.	225.00	.45
Potassium sulphate.....ton	17.00	21.00
Rochelle salts (see sodium potas, tartrate).....lb.	1.15	1.25
Salammoniac (see ammonium chloride).....lb.	1.15	1.25
Sal soda (see sodium carbonate).....lb.	1.15	1.25
Salt cake (sodium sulphate).....ton	17.00	21.00
Silver cyanide.....oz.	1.15	1.25
Silver nitrate.....oz.	1.15	1.25
Soda ash, light.....100 lb.	2.00	2.05
Soda ash, dense.....100 lb.	2.25	2.35
Sodium acetate.....lb.	.05 1/2	.06 1/2
Sodium bicarbonate.....100 lb.	2.40	2.75
Sodium bichromate.....lb.	1.12 1/2	1.21
Sodium bisulphate (nitre cake).....ton	3.00	8.00
Sodium bisulphite.....cwt.	1.80	1.90
Sodium borate (borax).....lb.	.07 1/2	.08
Sodium carbonate (sal soda).....100 lb.	1.35	1.50
Sodium chlorate.....lb.	.15	.16
Sodium cyanide.....lb.	.30	.31
Sodium fluoride.....lb.	.14	.15
Sodium hydroxide (caustic soda).....100 lb.	3.32	3.40
Sodium molybdate.....lb.	2.50	3.25
Sodium nitrate.....100 lb.	3.00	3.25
Sodium nitrite.....lb.	.15	.17
Sodium peroxide, powdered.....lb.	.30	.32
Sodium phosphate, dibasic.....lb.	.03 1/2	.04
Sodium potassium tartrate (Rochelle salts).....lb.	.24 1/2	.26
Sodium prussiate, yellow.....lb.	.01 1/2	.02
Sodium silicate, solution (40 deg.).....lb.	.02 1/2	.03
Sodium silicate, solution (60 deg.).....lb.	.02 1/2	.03
Sodium sulphate, crystals (Glauber's salts) cwt.	1.15	1.25
Sodium sulphide, crystal, 60-62 per cent. (conc).....lb.	.05	.06
Sodium sulphite, crystals.....lb.	.03 1/2	.04
Strontium nitrate, crystals.....lb.	.25	.28
Sulphur chloride.....lb.	.05 1/2	.06
Sulphur, crude.....ton	22.00	28
Sulphur dioxide, liquid, cylinders.....lb.	3.10	3.40
Sulphur (sublimed), flour.....100 lb.	2.95	3.15
Sulphur, roll (brimstone).....100 lb.	2.95	3.15
Tin bichloride (stannous).....lb.	.44	.46
Tin oxide.....lb.	.60	.60
Zinc carbonate, precipitate.....lb.	.20	.20
Zinc chloride, gran.....lb.	.12 1/2	.13 1/2
Zinc cyanide.....lb.	.49	.50
Zinc dust.....lb.	.09	.11
Zinc oxide, dry American.....lb.	.09 1/2	.09 1/2
Zinc sulphate.....lb.	.03 1/2	.04

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.00	\$1.10
Alpha naphthol, refined.....lb.	1.40	1.50
Alpha naphthylamine.....lb.	.32	.50
Aniline oil, drums extra.....lb.	.34	.35
Aniline salts.....lb.	.37	.37
Anthracene, 80% in drums (100 lb.).....lb.	.90	1.00
Benzaldehyde (f.f.c.).....lb.	1.00	1.15
Benzidine, base.....lb.	1.00	1.25
Benzidine, sulphate.....lb.	.90	1.15
Benzoic acid, U. S. P.....lb.	.90	1.10
Benzoate of soda, U. S. P.....lb.	.85	1.10
Benzol, pure, water-white, in drums (100 lb.).....gal.	.32	.36
Benzol, 90% in drums (100 lb.).....gal.	.35	.36
Benzyl chloride, 95-97% refined.....lb.	.35	.40
Benzyl chloride, tech.....lb.	.25	.35
Beta naphthol benzoate.....lb.	3.75	4.50
Beta naphthol, sublimed.....lb.	.75	.80
Beta naphthol, tech.....lb.	.45	.55
Beta naphthylamine, sublimed.....lb.	2.25	2.35
Creosol, U. S. P., in drums (100 lb.).....lb.	.18	.25
Ortho-cresol, in drums (100 lb.).....lb.	.23	.25
Creosylic acid, 97-99%, straw color, in drums.....gal.	.80	.85
Creosylic acid, 95-97%, dark, in drums.....gal.	.85	.90
Creosylic acid, 50%, first quality, drums.....gal.	.60	.60
Dichlorobenzol.....lb.	.07	.10
Diethylaniline.....lb.	1.40	2.25
Dimethylaniline.....lb.	.55	.60
Dinitrobenzol.....lb.	.26	.37
Dinitrochlorobenzol.....lb.	.25	.30
Dinitronaphthalene.....lb.	.45	.55
Dinitrophenol.....lb.	.32	.36
Dinitrotolul.....lb.	.38	.45
Dip oil, 25%, tar acids, car lots, in drums.....gal.	.38	.65
Diphenylamine.....lb.	.58	.75
H-acid.....lb.	1.60	1.75
Metaphenylenediamine.....lb.	1.15	1.80
Monochlorobenzol.....lb.	.12	.15
Monothylaniline.....lb.	1.50	1.75
Naphthalene crushed, in bbls. (250 lb.).....lb.	.06	.08
Naphthalene, flake.....lb.	.06 1/2	.07 1/2
Naphthalene, balls.....lb.	.08 1/2	.10
Naphthionic acid, crude.....lb.	.75	1.25
Nitrobenzol.....lb.	.14	.19
Nitro-naphthalene.....lb.	.35	.45
Nitro-tolul.....lb.	.27	.20
Ortho-amidophenol.....lb.	3.00	4.25
Ortho-dichlorobenzol.....lb.	.15	.20
Ortho-nitro-phenol.....lb.	.90	1.25
Ortho-nitro-tolul.....lb.	.25	.40
Ortho-toluidine.....lb.	.25	.45
Para-amidophenol, base.....lb.	2.50	3.50
Para-amidophenol, HCl.....lb.	2.50	3.25
Para-dichlorobenzol.....lb.	.15	.18
Paranitraniline.....lb.	.95	1.10
Para-nitro-tolul.....lb.	1.35	1.50
Paraphenylenediamine.....lb.	2.50	4.00
Paratoluidine.....lb.	1.75	2.50
Phthalic anhydride.....lb.	1.50	2.15
Phenol, U. S. P., drums (dest.), (240 lb.).....lb.	1.21	.16
Pyridin.....gal.	2.50	3.75
Resorcin, technical.....lb.	3.50	6.75
Resorcin, pure.....lb.	6.50	6.75
Salicylic acid, tech., in bbls. (110 lb.).....lb.	.37	.45
Salicylic acid, U. S. P.....lb.	.45	.50
Salol.....lb.	.90	.95
Solvent naphtha, water-white, in drums, 100 gal.....gal.	.20	.27
Solvent naphtha, crude, heavy, in drums, 100 gal.....gal.	.18	.24
Sulphanilic acid, crude.....lb.	.25	.30

Tolidine.....	lb.	\$1.70	—	\$2.50
Toluol, mixed.....	lb.	.45	—	.55
Toluol, in tank cars.....	gal.	.26	—	.30
Toluol, in drums.....	gal.	.27	—	.30
Xylidine, drums, 100 gal.....	lb.	.44	—	.50
Xylol, pure, in drums.....	gal.	.37	—	.45
Xylol, pure, in tank cars.....	gal.	.35	—	.40
Xylol, commercial, in drums, 100 gal.....	gal.	.23	—	.27
Xylol, commercial, in tank cars.....	gal.	.22	—	.25

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow.....	lb.	\$0.42	—	\$0.44
Beeswax, refined, yellow.....	lb.	.47	—	.48
Beeswax, white pure.....	lb.	.64	—	.66
Carnauba, No. 1.....	lb.	.85	—	.87
Carnauba, No. 2, regular.....	lb.	.65	—	.78
Carnauba, No. 3, North Country.....	lb.	.48	—	.50
Japan.....	lb.	.18	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb.	.06	—	.06
Paraffine waxes, crude, scale 124-126 m.p.....	lb.	.06	—	.06
Paraffine waxes, refined, 118-120 m.p.....	lb.	.07	—	.08
Paraffine waxes, refined, 128-130 m.p.....	lb.	.09	—	.09
Paraffine waxes, refined, 133-135 m.p.....	lb.	.10	—	.11
Paraffine waxes, refined, 135-137 m.p.....	lb.	.12	—	.13
Stearic acid, single pressed.....	lb.	.26	—	.28
Stearic acid, double pressed.....	lb.	.27	—	.29
Stearic acid, triple pressed.....	lb.	.31	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940.....	gal.	\$1.10	—	
Pine oil, pure, dest. dist.....	gal.	.96	—	
Pine tar oil, ref., sp. gr. 1.025-1.035.....	gal.	.45	—	
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.34	—	
Pine tar oil, double ref., sp. gr. 0.965-0.990.....	gal.	.65	—	
Pine tar, ref., thin, sp. gr. 1.080-1.960.....	gal.	.38	—	
Turpentine, crude, sp. gr. 0.900-0.970.....	gal.	.85	—	
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990.....	gal.	.30	—	
Pinewood creosote, ref.....	gal.	.48	—	

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.....	280 lb.	\$17.30	—	\$18.95
Rosin E-I.....	280 lb.	18.35	—	22.40
Rosin K-N.....	280 lb.	20.20	—	24.00
Rosin W. G-W. W.....	280 lb.	23.00	—	27.00
Wood rosin, bbl.....	280 lb.	16.00	—	17.00
Spirits of turpentine.....	gal.	1.63	—	1.65
Wood turpentine, steam dist.....	gal.	1.50	—	1.48
Wood turpentine, dest. dist.....	gal.	1.48	—	1.48
Pine tar pitch, bbl.....	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.).....	bbl.	13.50	—	14.25
Retort tar, bbl.....	280 lb.	14.50	—	14.90
Rosin oil, first run.....	gal.	.86	—	.91
Rosin oil, second run.....	gal.	.88	—	.93
Rosin oil, third run.....	gal.	.95	—	1.10
Rosin oil, fourth run.....	gal.	1.05	—	1.15

Solvents

73-76 deg., steel bbls. (85 lb.).....	gal.	\$0.33	—	
70-72 deg., steel bbls. (85 lb.).....	gal.	.31	—	
68-70 deg., steel bbls. (85 lb.).....	gal.	.30	—	
V. M. and P. naphtha, steel bbls. (85 lb.).....	gal.	.23	—	

Crude Rubber

Para-Upriver fine.....	lb.	\$0.51	—	\$0.52
Upriver coarse.....	lb.	.34	—	.35
Upriver caucho ball.....	lb.	.34	—	.37
Plantation—First latex crepe.....	lb.	.53	—	.53
Ribbed smoked sheets.....	lb.	.52	—	.52
Brown crepe, thin, clean.....	lb.	.42	—	.48
Amber crepe No. 1.....	lb.	.48	—	.48

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.....	lb.	\$0.18	—	\$0.19
Castor oil, AA, in bbls.....	lb.	.21	—	.22
China wood oil, in bbls.....	lb.	.22	—	.22
Cocoonut oil, Ceylon grade, in bbls.....	lb.	.17	—	.18
Cocoonut oil, Cochinchina grade, in bbls.....	lb.	.19	—	.20
Corn oil, crude, in bbls.....	lb.	.17	—	.18
Cottonseed oil, crude (f.o.b. mill).....	lb.	.18	—	.19
Cottonseed oil, summer yellow.....	lb.	.23	—	.24
Cottonseed oil, winter yellow.....	lb.	.24	—	.25
Linseed oil, raw, car lots.....	gal.	1.70	—	1.73
Linseed oil, raw, tank cars.....	gal.	1.65	—	1.70
Linseed oil, boiled, car lots.....	gal.	1.70	—	1.74
Olive oil, commercial.....	gal.	2.40	—	2.50
Palm, Lagos.....	lb.	.17	—	.17
Palm, bright red.....	lb.	.16	—	.17
Palm, Niger.....	lb.	.16	—	.17
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.21	—	.22
Peanut oil, refined, in bbls.....	lb.	.26	—	.27
Rapeseed oil, refined in bbls.....	gal.	1.50	—	1.60
Rapeseed oil, blown in bbls.....	gal.	1.60	—	1.70
Soya bean oil (Manchurian), in bbls., N. Y.....	lb.	.17	—	.18
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.16	—	.16

FISH

Winter pressed Menhaden.....	gal.	\$1.20	—	
Yellow bleached Menhaden.....	gal.	1.23	—	
White bleached Menhaden.....	gal.	1.25	—	
Blown Menhaden.....	gal.	1.30	—	

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated.....	ton	\$25.00	—	\$36.00
Barytes, off color.....	ton	20.00	—	25.00
Blanc fixe, dry.....	lb.	.03	—	.04
Blanc fixe, pulp.....	ton	35.00	—	47.50
Casein.....	lb.	.16	—	.18
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.04	—	.06

Chalk, English, dense.....	lb.	\$.04	—	\$.05
China clay (Kaolin), imported, lump.....	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered.....	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump.....	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered.....	ton	25.00	—	40.00
Felspar.....	ton	12.00	—	16.00
Fluorspar, acid grade, lump, f.o.b. mines.....	net ton	30.00	—	35.00
Fluorspar, acid grade, ground, f.o.b. mines.....	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered.....	ton	30.00	—	40.00
Fuller's earth, imported, powdered.....	ton	.....	—	.....
Pumice stone, imported.....	lb.	.03	—	.06
Pumice stone, domestic.....	lb.	.02	—	.....
Shellac, T.N.....	lb.	1.00	—	.....
Shellac, D. C.....	lb.	.....	—	.....
Shellac, V. S. O.....	lb.	.....	—	.....
Shellac, Diamond I.....	lb.	.....	—	.....
Shellac, orange, fine.....	lb.	1.05	—	.....
Shellac, orange, superfine.....	lb.	1.10	—	1.30
Shellac, A.C. garnet.....	lb.	1.00	—	.....
Shellac, bleached, bone dry.....	lb.	1.25	—	.....
Shellac, bleached, fresh ground.....	lb.	1.20	—	.....
Soapstone.....	ton	15.00	—	25.00
Talc, domestic.....	ton	16.00	—	60.00
Talc, imported.....	ton	55.00	—	60.00

Refractories

Following prices are f.o.b. works:

Chrome brick.....	net ton	80-90 at Chester, Penn.
Chrome cement.....	net ton	45-50 at Chester, Penn.
Clay brick, 1st quality fireclay.....	net ton	35-45 at Clearfield, Penn.
Clay brick, 2nd quality.....	net ton	30-35 at Clearfield, Penn.
Magnesite, dead burned.....	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4 1/2 x 2 1/2 in.....	net ton	80-90 at Chester, Penn.
Silica brick.....	net ton	41-45 at Mt. Union, Penn.

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon.....	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon.....	lb.	.70	—	.....
Ferro-manganese, 70-80% Mn.....	gross ton	105.00	—	115.00
Spiegelisen, 16-20% Mn.....	gross ton	35.00	—	36.00
Ferro-molybdenum, per lb. of Mo.....	lb.	2.50	—	3.06
Ferro-silicon, 50%.....	gross ton	85.00	—	95.00
Ferro-silicon, 75%.....	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%.....	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.....	lb.	1.25	—	1.40
Ferro-uranium, 35-50% of U.....	lb.	7.00	—	.....
Ferro-vanadium, 30-40% per lb. of contained V.....	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40%, Cr ₂ O ₃	unit	\$0.60	—	\$0.80
Chrome ore, 48% and over.....	unit	.85	—	1.00
Coke, foundry, f.o.b. ovens.....	net ton	5.50	—	6.00
Coke, furnace, f.o.b. ovens.....	net ton	4.00	—	5.00
Petroleum coke, refinery, Atlantic seaboard.....	net ton	13.00	—	.....
Fluorspar, gravel, f.o.b. mines.....	net ton	20.00	—	25.00
Manganese ore, 45% Mn and over.....	unit	.50	—	.75
Manganese ore, chemical (MnO ₂).....	gross ton	60.00	—	70.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	9.00	—	15.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃	unit	7.50	—	10.00
Uranium oxide, 96%.....	lb.	.....	—	.....
Vanadium pentoxide, 99%.....	lb.	6.00	—	.....
Pyrites, foreign, lump.....	unit	.13	—	.....
Pyrites, foreign, fine.....	unit	.14	—	.....
Pyrites, domestic, fine.....	unit	.14	—	.17
Ilmenite, 52% TiO ₂ , f.o.b. N. Y.....	net ton	40.00	—	.....
Rutile, 95% TiO ₂ , f.o.b. N. Y.....	net ton	220.00	—	.....
Carnotite, minimum 2% U ₃ O ₈ , per lb. of U ₃ O ₈	lb.	2.75	—	3.00
Zircon, washed, iron free, f.o.b. N. Y.....	net ton	200.00	—	.....
Monazite, per unit of ThO ₂ , f.o.b. N. Y.....	unit	42.00	—	.....

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags.....	bbl.	\$2.80	—	
Lump lime, common, including container.....	300 bbl.	2.65	—	
Common brick, at dock.....	M.	16.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under.....	M.	48.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago.....	M.	50.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis.....	M.	40.00	—	
Roofings, tar felt (14 lb. per 100 sq.ft.).....	ton	70.00	—	
Roofings, tar pitch (in 400-lb. bbl.) carlots.....	ton	21.00	—	
Roofings, asphalt pitch carlots.....	ton	34.00	—	
Roofings, asphalt felt carlots.....	ton	68.00	—	
Roofings, slate-surfaced, per roll of 108 sq.ft. carlots.....	.....	2.25	—	
Roofings, slate-finished shingles, 100 sq.ft. carlots.....	.....	6.00	—	
Linseed oil, raw in barrels.....	gal.	1.75	—	
Linseed oil, 5 gal. cans.....	gal.	1.88	—	
Red lead, dry, 100 lb. keg.....	lb.	.13	—	
Red lead, in oil, 100 lb. keg.....	lb.	.14	—	
Red lead, dry, 5 lb. cans.....	lb.	.15	—	
Red lead, in oil, 5 lb. cans.....	lb.	.16	—	
White lead, dry and in oil, 100 lb. keg.....	lb.	.13	—	
White lead, dry and in oil, 25 and 50 lb. kegs.....	lb.	.13	—	
White lead, dry and in oil, 5 lb. cans.....	lb.	.15	—	

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.....	100 lb.	\$2.45	—	
Angles, 3 to 6-in., 1-in. thick.....	100 lb.	2.45	—	
Tees, 3-in. and larger.....	100 lb.	2.45	—	
Plates.....	100 lb.	2.66	—	
Rivets, structural, 1-in. and larger.....	100 lb.	4.20	—	
Rivets, conehead for boilers, 1-in. and larger.....	100 lb.	4.30	—	
Sheets, No. 28 black.....	100 lb.	4.35	—	
Sheets, No. 10 blue annealed.....	100 lb.	3.55	—	
Sheets, No. 28 galvanized.....	100 lb.	5.70	—	

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

Current Market Reports

The Non-Ferrous Metal Market

Friday, Oct. 31.—A tendency to advance prices is noted wherever sufficient demand exists to warrant it.

Aluminum:—Ingot aluminum continues at the old fixed price of 33c. lb.

Antimony:—The demand for antimony is good and prices are from 8½ to 9c. lb.

Copper:—No important trading is taking place with 22c. lb. being asked.

Copper sheets, hot-rolled.....	lb.	\$0.32½
Copper bottoms.....	lb.	.40½
Copper rods.....	lb.	.28
Copper wire.....	lb.	.28½
High brass wire and sheets.....	lb.	.26½
High brass rods.....	lb.	.26½
Low brass wires and sheets.....	lb.	.25½
Low brass rods.....	lb.	.30½
Brazed brass tubing.....	lb.	.38
Brazed bronze tubing.....	lb.	.43½
Seamless copper tubing.....	lb.	.35½
Seamless bronze tubing.....	lb.	.43½
Seamless brass tubing.....	lb.	.34
Bronze (gold) powder.....	lb.	1.00

Lead:—Large quantities of lead, such as white lead pigments, are being absorbed in peace-time pursuits. Prices range from 5.85 to 6c. lb.

Zinc:—This market continues to strengthen, with 7.7c. lb. being the present level.

OTHER METALS

Bismuth.....	lb.	\$3.20 — \$3.65
Cadmium.....	lb.	1.40 —
Cobalt.....	lb.	2.50 — 3.50
Magnesium.....	lb.	1.75 — 2.10
Mercury.....	75 lb.	95.00 —
Nickel.....	lb.	.40 — .45
Iridium.....	oz.	175.00 —
Palladium.....	oz.	115.00 — 120.00
Platinum.....	oz.	130.00 —
Silver.....	oz.	1.23½ —

The Iron and Steel Market

Much less scarcity of steel is reflected than was expected would be developed by six weeks of even a very partial strike. There are few cases of manufacturing consumers having had to curtail their operations, though possibly a few weeks more of a 60 or 70 per cent steel production might force many to do so. Steel mills are indisposed to discuss the extent to which they have been modifying their distribution of steel for the purpose of helping customers most in need of steel, but it is probable that much of this has been done, and it is generally understood that shipments have been much heavier, proportionately, to manufacturing consumers than to jobbers. Stocks of the latter are now showing signs of being ragged.

It is practically certain that the United States Steel Corporation and some at least of the large independents will oppose there being any advances in finished steel prices. Small mills, that do not normally sell far ahead, will probably be able to secure delivery premiums, and indeed a little business of this description has already been done, particularly in sheets and merchant bars.

Pig iron, on the other hand, is advancing rather sharply as to foundry grade, this being a continuation and an accentuation of the advancing tendency that was first apparent at the close of last June. Buffalo and Birmingham showed the first stiffening, about July 1, being followed by Philadelphia. Lately Cleveland and Chicago have begun advancing, and in the past week foundry iron at valley furnaces has become quotable at \$2 advance, for forward deliveries, making \$28.75, furnaces, against the March 21 price of \$26.75. The strike has not curtailed the operation of iron foundries, while it has somewhat curtailed the production of merchant iron, perhaps by a slightly greater extent than the consumption by steel works that use merchant iron has been curtailed.

A weighted average of pig iron prices shows that, with the recent advances, pig iron is now 81 per cent above its ten-year pre-war average, or the same percentage that is shown by a similar comparison of the March 21 prices of finished steel, which still rule. The Dun and Bradstreet index numbers show a mean advance of 120 per cent above their ten-year pre-war averages.

The Chemical Market

New York, November 1, 1919.

Although the harbor strike here has caused a great amount of inconvenience, to date it has not created an acute situation. Available supplies are rapidly diminishing, but the general opinion is that the situation will clear before the shortage becomes general. Naval stores are probably in a worse plight than other commodities. There are practically no spot supplies of rosins or spirits of turpentine available. But in their case, as in that of many other products, there are supplies in the harbor either on lighters or aboard ship. Coal-tar products are in the same position they have held for some weeks past, the bulk of activity being centered on meeting previous contracts. While there is a scarcity of paratoluidine, paranitrophenol, dinitrophenol, dimethylaniline, aniline oil and salts, there are fair quantities of supplies of other coal-tar products available in which a good business is being done. Aniline oil is being offered on contract for delivery next year at 28c. per lb. Vegetable oils have maintained a firm tone, although the market at present is mostly speculative. The crude rubber market was dull throughout the week until Friday, when it gained some strength due to stronger foreign markets. There were a few inquiries from manufacturers, but the major activity was confined to trading among dealers. Stocks of rubber in store are limited; there are, however, large quantities on steamers in the harbor. As a natural result of the lifting of the steel strike, business in ores and ferro-alloys is beginning to revive. Indicative of this is the good domestic inquiry reported for tungsten ore, high grade wolframite and for ferromanganese. Several thousand tons of spiegeleisen have been sold to Holland and Belgium.

Chicago, October 31, 1919.

With the exception of a general increase of from 10 to 15 per cent in vegetable oils and a few isolated advances in certain items of the heavy chemical line, the market in this district presents no spectacular feature.

Heavy Chemicals:—Potassium prussiate, under steady demand, holds firmly to previously established high prices, \$1.10 per lb. being readily obtained for the red and 70c. for the yellow. Sodium bichromate shows slightly added strength with 14c. the current quotation. Acetone at 15c. is below quotations of a fortnight ago. With buyers sufficiently active to prevent any accumulation of surplus stocks, old prices of 3½c. per lb. for solid caustic soda and 4c. for the granulated still hold good. Soda ash and bleaching powder both are quoted at 2c.

Vegetable Oils:—Following the slump in prices of all vegetable oils on Oct. 1, buyers have re-entered the market with the effect of stiffening all prices.

Miller grade cocoanut oil in tanks has recovered from the low quotation of 16½c. to 18½c., and spot corn oil is firmly held at 18-18½c. Offers of corn oil in tanks are not below 16c. Crude cottonseed is up 2c., 19c. being asked at present, 24c. still holding for prime summer yellow. Soya bean oil has shared in the general recovery, the current quotation being 16 to 16½c., Coast. Linseed oil continues to fluctuate, the quotation ruling today being \$1.73 per gal., which was the figure two weeks ago.

Flotation Oils, Naval Stores, in accordance with their habit of several months past, continue to hold much interest. Pine oil has been the most active, the .933 steam distilled having advanced from \$1.05 to \$1.25 per gal. in the past two weeks. A very definite shortage is the cause for this advance. This market supplies many manufacturers of disinfectants, paints, varnishes, and linoleum, and ore handlers, with great quantities of pine oil, and the recent prosperity of these various industrial lines has caused unusually heavy demand. Destructively distilled pine oil remains at 95c. per gal.

Turpentine, contrary to expectation, has continued to remain low, compared with prices earlier in the year. It has fluctuated from \$1.55 on Oct. 9 to \$1.50, and is today quoted at \$1.62.

Not much change has occurred in rosin, F being quoted at \$18 and W at \$24.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, NOV. 3, 1919

	Carlots	Less Carlots	Carlots	Less Carlots
Acetic anhydride.....lb.				
Acetone.....lb.	\$0.13-0.14	\$0.55-0.60		
Acid, acetic, 28 per cent.....cwt.	2.50-2.65	3.00-3.25		
Acetic, 56 per cent.....cwt.	5.00-5.50	6.00-6.50		
Acetic, glacial, 99 1/2 per cent, carboys.....cwt.	12.00-12.50	12.90-13.50		
Boric, crystals.....lb.	.13-.14	.13-.14		
Boric, powder.....lb.	.13-.14	.13-.14		
Hydrochloric, (muriatic) tech. 20 deg.....cwt.	1.50-1.75	2.00-2.50		
Hydrofluoric, 52 deg.....lb.	.12-.14	.14-.16		
Lactic, 44 per cent, tech.....lb.	.11-.14	.12-.16		
Lactic, 22 per cent, tech.....lb.	.05-.06	.05-.07		
Molybdic, C. P.....lb.		4.00-4.25		
Nitric, 40 deg.....lb.	.06-.06 1/2	.07-.08 1/2		
Nitric, 42 deg.....lb.	.07-.07 1/2	.08-.09		
Oxalic, crystals.....lb.	.23-.25	.25-.30		
Phosphoric, Ortho, 50 per cent, solution.....lb.	.09-.10	.10-.14		
Picric.....lb.	.30-.35	.40-.50		
Pyrogallol, resublimed.....lb.		2.30-2.60		
Sulphuric, 60 deg., tank cars.....ton	12.00-16.00			
Sulphuric, 60 deg., drums.....ton	17.00-	22.00-		
Sulphuric, 60 deg., carboys.....ton	20.00-	25.00-		
Sulphuric, 66 deg., tank cars.....ton	17.00-18.00	22.00-23.00		
Sulphuric, 66 deg., drums.....ton	20.00-21.00	25.00-26.00		
Sulphuric, 66 deg., carboys.....ton	25.00-	30.00-40.00		
Sulphuric, fuming, 20 per cent. (oleum) tank cars.....ton	20.00-	26.00-		
Sulphuric, fuming, 20 per cent. (oleum) drums.....ton	25.00-	32.00-		
Sulphuric, fuming, 20 per cent. (oleum) carboys.....ton	30.00-	35.00-		
Tannic, U. S. P.....lb.		1.35-1.45		
Tannic (tech.).....lb.		.42-.55		
Tartaric, crystals.....lb.		.72-.73		
Tungstic, per lb. of WO.....lb.		1.20-1.40		
Alcohol, Ethyl.....gal.	4.90-	4.95-		
Alcohol, Methyl.....gal.	1.30-	1.33-1.38		
Alcohol, denatured, 188 proof.....gal.	.58-.60	.60-.64		
Alcohol, denatured, 190 proof.....gal.	.54-.56	.56-.60		
Alum, ammonia lump.....lb.	.03-.04 1/2	.04-.04 1/2		
Alum, potash lump.....lb.	.08-.08 1/2	.09-.09 1/2		
Alum, chrome lump.....lb.	.15-.16	.18-.20		
Aluminum sulphate, commercial.....lb.	.01-.02	.02-.02 1/2		
Aluminum sulphate, iron free.....lb.	.02-.03	.03-.03 1/2		
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	.08-	.08 1/2-.08 1/2		
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.		.30-.35		
Ammonium carbonate, powder.....lb.	.13-.13 1/2	.14-.14 1/2		
Ammonium chloride, granular (white sal-ammoniac).....lb.	.12-.13	.13-.14		
Ammonium chloride, granular (gray sal-ammoniac).....lb.	.12-.12 1/2	.13-.13 1/2		
Ammonium nitrate.....lb.	.10-	.11-.12		
Ammonium sulphate.....lb.	.05-	.06-.06 1/2		
Amyl acetate.....gal.		3.65-3.75		
Arsenic, oxide, lumps (white arsenic).....lb.		.10-.11		
Arsenic, sulphide, powdered (red arsenic).....ton	85.00-	90.00-100.00		
Barium chloride.....lb.	.22-	.24-		
Barium nitrate.....lb.	.10-.10 1/2	.11-.12		
Barium sulphate (precip.) (blanc fixe).....lb.	.03-.03 1/2	.03 1/2-.04		
Bleaching powder (see calcium hypochlorite).....cwt.				
Blue Vitriol (see copper sulphate).....cwt.				
Borax (see sodium borate).....cwt.				
Bromine (see sulphur, roll).....lb.		.65-.75		
Calcium acetate.....cwt.	2.00-2.05	2.10-		
Calcium carbide.....lb.		.04-.05		
Calcium chloride, fused, lump.....ton	19.00-25.00	30.00-40.00		
Calcium chloride, granulated.....lb.	.01-.01 1/2	.02-.02 1/2		
Calcium hypochlorite (bleaching powder).....cwt.	2.25-2.50	1.50-1.70		
Calcium peroxide.....lb.		.75-.75		
Calcium phosphate, monobasic.....lb.		.09-.09 1/2		
Calcium sulphate, precipitated.....lb.	.05-	.06-.06 1/2		
Carbon bisulphide.....lb.	.10-.11	.12-.14		
Carbon tetrachloride, drums.....lb.		.75-		
Carbonyl chloride (phosgene).....lb.				
Caustic potash (see potassium hydroxide).....lb.				
Caustic soda (see sodium hydroxide).....lb.				
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	.05-.05 1/2	.08-.1.55		
Cobalt oxide.....lb.		1.50-1.55		
Coppers (see iron sulphate).....lb.				
Copper carbonate, green precipitate.....lb.		.65-.70		
Copper cyanide.....lb.		.85-.86 1/2		
Copper sulphate, crystals.....lb.	.08 1/2-.08 1/2	.09-.09 1/2		
Cream of tartar (see potassium bitartrate).....lb.				
Epsom salt (see magnesium sulphate).....lb.				
Formaldehyde, 40 per cent.....lb.		.25-.27		
Glauber's salt (see sodium sulphate).....lb.				
Glycerine.....lb.		.45-.21		
Iodine, resublimed.....lb.		.03-.20		
Iron oxide, red.....lb.		1.20-1.50		
Iron sulphate, (copperas).....cwt.	1.00-	.12-.14 1/2		
Lead acetate, normal.....lb.		.13-.17		
Lead arsenate (paste).....lb.		.85-.86 1/2		
Lead nitrate, crystals.....lb.		.09-.10 1/2		
Litharge.....lb.		.50-		
Lithium Carbonate.....lb.		.13-.14 1/2		
Magnesium carbonate, technical.....lb.		.75-3.00		
Magnesium sulphate, U. S. P.....100 lb.	2.00-2.65	2.00-2.50		
Magnesium sulphate, commercial.....100 lb.	1.75-	.15-		
Nickel salt, double.....lb.	.14-	.15-.16		
Nickel salt, single.....lb.	.12-			
Phosgene (see carbonyl chloride).....lb.				
Phosphorus, red.....lb.		.60-.70		
Phosphorus, yellow.....lb.		.35-.37		
Potassium bichromate.....lb.	.25-.26	.55-.60		
Potassium bitartrate (cream of tartar).....lb.		.50-.60		
Potassium bromide, granular.....lb.		.50-.65		
Potassium carbonate, U. S. P.....lb.	.60-	.28-		
Potassium carbonate, crude.....lb.	.25-	.21-		
Potassium chlorate, crystals.....lb.	.19-.20			
Potassium cyanide, 98-99 per cent.....lb.	nominal	.35-.40		
Potassium hydroxide (caustic potash).....lb.		3.55-3.60		
Potassium iodide.....lb.	.19-	.21-		
Potassium nitrate.....lb.		.55-.65		
Potassium permanganate.....lb.		1.05-1.15		
Potassium prussiate, red.....lb.				
Potassium prussiate, yellow.....lb.				
Potassium sulphate.....ton	225.00-			
Rochelle salts (see sodium potas. tartrate).....ton				
Sal ammoniac (see ammonium chloride).....ton				
Salt soda (see sodium carbonate).....ton				
Salt cake (sodium sulphate).....ton	17.00-21.00			
Silver cyanide.....oz.		.76-1.77 1/2		
Silver nitrate.....oz.		2.00-2.05		
Soda ash, light.....100 lb.	1.90-	2.50-2.75		
Soda ash, dense.....100 lb.	2.25-	.07-.08		
Sodium acetate.....lb.	.05 1/2-.06 1/2	2.75-3.00		
Sodium bicarbonate.....100 lb.	2.35-	.12-.13		
Sodium bichromate.....lb.	.12-	10.00-		
Sodium bisulphate (nitre cake).....ton	3.00-8.00	2.00-2.10		
Sodium bisulphite.....cwt.	1.80-1.90	.08-.08 1/2		
Sodium borate (borax).....lb.	.07 1/2-	1.50-1.75		
Sodium carbonate (sal soda).....100 lb.	1.35-1.50	.16-.18 1/2		
Sodium chlorate.....lb.	.15-	.31-.34		
Sodium cyanide.....lb.	.30-	.15-.16		
Sodium fluoride.....lb.	.14-	3.45-3.50		
Sodium hydroxide (caustic soda).....100 lb.	3.30-3.40	3.25-		
Sodium molybdate.....lb.	2.50-	3.75-4.00		
Sodium nitrate.....100 lb.	3.00-3.25	.30-.32		
Sodium nitrite.....lb.	.14-.17	.04-.05		
Sodium peroxide, powdered.....lb.		.43-.45 1/2		
Sodium phosphate, dibasic.....lb.	.03 1/2-.04	.27-.28		
Sodium potassium tartrate (Rochelle salts).....lb.		.02-.02 1/2		
Sodium prussiate, yellow.....lb.	.25-.26	.03 1/2-.04 1/2		
Sodium silicate, solution (40 deg.).....lb.	.61 1/2-.02	1.50-2.00		
Sodium silicate, solution (60 deg.).....lb.	.02 1/2-.03			
Sodium sulphate, crystals (Glauber's salts) cwt.	1.15-1.25			
Sodium sulphide, crystal, 60-62 per cent. (conc).....lb.		.05-.06		
Sodium sulphite, crystals.....lb.	.03 1/2-	.04-.06		
Strontium nitrate, crystals.....lb.	.25-	.28-		
Sulphur chloride.....lb.	.05 1/2-	.06-		
Sulphur, crude.....ton	22.00-	.10-.12		
Sulphur dioxide, liquid, cylinders.....lb.		3.40-3.65		
Sulphur (sublimed), flour.....100 lb.	3.10-	3.15-3.40		
Sulphur, roll (brimstone).....100 lb.	2.95-	.46-.50		
Tin bichloride (stannous).....lb.	.44-	.60-		
Tin oxide.....lb.		.20-		
Zinc carbonate, precipitate.....lb.		.13-.14		
Zinc chloride, gran.....lb.	.12 1/2-	.50-		
Zinc cyanide.....lb.	.49-	.11-.14		
Zinc dust.....lb.	.09-.11	.09 1/2-.09 1/2		
Zinc oxide, dry American.....lb.		.04-.04 1/2		
Zinc sulphate.....lb.	.03 1/2-.03 1/2			

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.00-	\$1.10
Alpha naphthol, refined.....lb.	1.40-	1.50
Alpha naphthylamine.....lb.	.32-	.50
Aniline oil, drums extra.....lb.	.32-	.35
Aniline salts.....lb.	.36-	.39
Anthracene, 80% in drums (100 lb.).....lb.	.90-	1.00
Benzaldehyde (f.f.c.).....lb.	1.00-	1.15
Benzidine, base.....lb.	1.10-	1.25
Benzidine, sulphate.....lb.	.90-	1.15
Benzoic acid, U. S. P.....lb.	.90-	1.10
Benzene of soda, U. S. P.....lb.	.85-	1.10
Benzol, pure, water-white, in drums (100 lb.).....gal.	.32-	.36
Benzol, 90% in drums (100 lb.).....gal.	.24-	.28
Benzyl chloride, 95-97%, refined.....lb.	.35-	.40
Benzyl chloride, tech.....lb.	.25-	.35
Beta naphthol benzoate.....lb.	3.75-	4.50
Beta naphthol, sublimed.....lb.	.75-	.80
Beta naphthol, tech.....lb.	.47-	.55
Beta naphthylamine, sublimed.....lb.	2.25-	2.35
Cresol, U. S. P., in drums (100 lb.).....lb.	.18-	.25
Ortho-cresol, in drums (100 lb.).....lb.	.23-	.25
Cresylic acid, 97-99%, straw color, in drums.....gal.	.80-	.85
Cresylic acid, 95-97%, dark, in drums.....gal.	.85-	.90
Cresylic acid, 50%, best quality, drums.....gal.	.60-	.70
Dichlorobenzol.....lb.	.07-	.10
Diethylaniline.....lb.	1.40-	2.25
Dimethylaniline.....lb.	.60-	.63
Dinitrobenzol.....lb.	.26-	.37
Dinitrochlorobenzol.....lb.	.25-	.30
Dinitronaphthalene.....lb.	.45-	.55
Dinitrophenol.....lb.	.33-	.36
Dinitrotoluol.....lb.	.38-	.45
Dip oil, 25% tar acids, car lots, in drums.....gal.	.38-	.65
Diphenylamine.....lb.	.58-	.75
H-acid.....lb.	1.60-	1.75
Metaphenylenediamine.....lb.	1.15-	1.80
Monochlorobenzol.....lb.	.12-	.15
Monochloroaniline.....lb.	1.50-	1.75
Naphthalene crushed, in bbls. (250 lb.).....lb.	.06-	.08
Naphthalene, flake.....lb.	.06 1/2-	.07 1/2
Naphthalene, balls.....lb.	.08 1/2-	.10
Naphthionic acid, crude.....lb.	.75-	1.25
Nitrobenzol.....lb.	.14-	.19
Nitro-naphthalene.....lb.	.35-	.45
Nitro-toluol.....lb.	.27-	.30
Ortho-amidophenol.....lb.	3.00-	4.25
Ortho-dichlorobenzol.....lb.	.15-	.20
Ortho-nitrophenol.....lb.	.90-	1.25
Ortho-nitro-toluol.....lb.	.25-	.40
Ortho-toluidine.....lb.	.25-	.45
Para-amidophenol, base.....lb.	2.50-	3.50
Para-amidophenol, HCl.....lb.	2.50-	3.25
Para-dichlorobenzol.....lb.	1.00-	1.18
Paranitraniline.....lb.	1.15-	1.50
Para-nitro-toluol.....lb.	1.35-	1.50
Paraphenylenediamine.....lb.	2.50-	4.00
Paratoluidine.....lb.	1.75-	2.00
Phthalic anhydride.....lb.	1.50-	2.15
Phenol, U. S. P., drums (dest.), (240 lb.).....gal.	.16-	.17
Pyridin.....lb.	2.50-	3.75
Resorcin, technical.....lb.	3.50-	6.75
Resorcin, pure.....lb.	6.50-	7.75
Salicylic acid, tech., in bbls. (110 lb.).....lb.	.37-	.45
Salicylic acid, U. S. P.....lb.	.45-	.50
Salol.....lb.	.90-	.95
Solvent naphtha, water-white, in drums, 100 gal. gal.	.20-	.27
Solvent naphtha, crude, heavy, in drums, 100 gal. gal.	.18-	.24
Sulphanilic acid, crude.....lb.	.25-	.30

Tolidine.....	lb.	\$1.70	—	\$2.50
Toluidine, mixed.....	lb.	.45	—	.55
Toluol, in tank cars.....	gal.	.26	—	.30
Toluol, in drums.....	gal.	.27	—	.30
Xylidine, drums, 100 gal.....	lb.	.44	—	.50
Xylol, pure, in drums.....	gal.	.37	—	.45
Xylol, pure, in tank cars.....	gal.	.35	—	.42
Xylol, commercial, in drums, 100 gal.....	gal.	.23	—	.27
Xylol, commercial, in tank cars.....	gal.	.22	—	.25

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow.....	lb.	\$0.42	—	\$0.44
Beeswax, refined, yellow.....	lb.	.46	—	.48
Beeswax, white pure.....	lb.	.64	—	.66
Carnauba, No. 1.....	lb.	.85	—	.88
Carnauba, No. 2, regular.....	lb.	.67	—	.80
Carnauba, No. 3, North Country.....	lb.	.48	—	.50
Japan.....	lb.	.18	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb.	.06	—	.07
Paraffine waxes, crude, scale 124-126 m.p.....	lb.	.06	—	.07
Paraffine waxes, refined, 118-120 m.p.....	lb.	.07	—	.08
Paraffine waxes, refined, 128-130 m.p.....	lb.	.09	—	.10
Paraffine waxes, refined, 133-135 m.p.....	lb.	.10	—	.11
Paraffine waxes, refined, 135-137 m.p.....	lb.	.12	—	.13
Stearic acid, single pressed.....	lb.	.26	—	.28
Stearic acid, double pressed.....	lb.	.27	—	.29
Stearic acid, triple pressed.....	lb.	.31	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940.....	gal.	\$1.10	—	
Pine oil, pure, dest. dist.....	gal.	.96	—	
Pine tar oil, ref., sp. gr. 1.025-1.035.....	gal.	.45	—	
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.34	—	
Pine tar oil, double ref., sp. gr. 0.965-0.990.....	gal.	.65	—	
Pine tar, ref., thin, sp. gr. 1.080-1.060.....	gal.	.38	—	
Turpentine, crude, sp. gr. 0.900-0.970.....	gal.	.85	—	
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990.....	gal.	.30	—	
Pinewood creosote, ref.....	gal.	.48	—	

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.....	280 lb.	\$17.50	—	\$
Rosin E-I.....	280 lb.	17.75	—	19.00
Rosin K-N.....	280 lb.	20.25	—	22.50
Rosin W. G. W. W.....	280 lb.	23.25	—	24.50
Wood rosin, bbl.....	280 lb.	16.50	—	17.00
Spirits of turpentine.....	gal.	1.58	—	
Wood turpentine, steam dist.....	gal.	1.50	—	
Wood turpentine, dest. dist.....	gal.	1.48	—	
Pine tar pitch, bbl.....	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.).....	bbl.	13.50	—	14.25
Retort tar, bbl.....	280 lb.	14.50	—	14.90
Rosin oil, first run.....	gal.	.86	—	.91
Rosin oil, second run.....	gal.	.88	—	.93
Rosin oil, third run.....	gal.	.95	—	1.07
Rosin oil, fourth run.....	gal.	1.05	—	1.10

Solvents

73-76 deg., steel bbls. (85 lb.).....	gal.	\$0.33	—	
70-72 deg., steel bbls. (85 lb.).....	gal.	.31	—	
68-70 deg., steel bbls. (85 lb.).....	gal.	.30	—	
V. M. and P. naphtha, steel bbls. (85 lb.).....	gal.	.23	—	

Crude Rubber

Para—Upriver fine.....	lb.	\$0.52	—	\$0.52
Upriver coarse.....	lb.	.35	—	
Upriver caucho ball.....	lb.	.35	—	.35
Plantation—First latex crepe.....	lb.	.53	—	
Ribbed smoked sheets.....	lb.	.52	—	.53
Brown crepe, thin, clean.....	lb.	.45	—	
Amber crepe No. 1.....	lb.	.48	—	

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.....	lb.	\$0.18	—	\$0.19
Castor oil, AA, in bbls.....	lb.	.21	—	.22
China wood oil, in bbls.....	lb.	.22	—	.23
Cocoonut oil, Ceylon grade, in bbls.....	lb.	.18	—	.18
Cocoonut oil, Cochin grade, in bbls.....	lb.	.19	—	.20
Corn oil, crude, in bbls.....	lb.	.18	—	.23
Cottonseed oil, crude (f.o.b. mill).....	lb.	.18	—	.19
Cottonseed oil, summer yellow.....	lb.	.23	—	.24
Cottonseed oil, winter yellow.....	lb.	.24	—	.25
Linseed oil, raw, car lots.....	gal.	1.70	—	
Linseed oil, raw, tank cars.....	gal.	1.65	—	1.70
Linseed oil, boiled, car lots.....	gal.	1.70	—	1.72
Olive oil, commercial.....	gal.	2.40	—	2.50
Palm, Lagos.....	lb.	.17	—	.17
Palm, bright red.....	lb.	.16	—	.17
Palm, Niger.....	lb.	.16	—	
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.22	—	.22
Peanut oil, refined, in bbls.....	lb.	.26	—	.27
Rapeseed oil, refined in bbls.....	gal.	1.50	—	1.60
Rapeseed oil, blown, in bbls.....	gal.	1.67	—	1.70
Soya bean oil (Manchurian), in bbls., N. Y.....	lb.	.17	—	.18
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.16	—	

FISH

Winter pressed Menhaden.....	gal.	\$1.28	—	
Yellow bleached Menhaden.....	gal.	1.30	—	\$1.31
White bleached Menhaden.....	gal.	1.32	—	
Blown Menhaden.....	gal.	1.34	—	1.38

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated.....	ton	\$25.00	—	\$36.00
Barytes, off color.....	ton	20.00	—	25.00
Blanc fixe, dry.....	lb.	.03	—	.04
Blanc fixe, pulp.....	ton	35.00	—	47.50
Casein.....	lb.	.16	—	.18
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.04	—	.06

Chalk, English, dense.....	lb.	\$.04	—	\$.05
China clay (Kaolin), imported, lump.....	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered.....	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump.....	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered.....	ton	25.00	—	40.00
Feldspar.....	ton	12.00	—	16.00
Fluorspar, acid grade, lump, f.o.b. mines.....	net ton	30.00	—	\$35.00
Fluorspar, acid grade, ground, f.o.b. mines.....	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered.....	ton	30.00	—	40.00
Fuller's earth, imported, powdered.....	ton	.....	—	.....
Pumice stone, imported.....	lb.	.03	—	.06
Pumice stone, domestic.....	lb.	.02	—	.....
Shellac, TN.....	lb.	1.00	—	.....
Shellac, D. C.....	lb.	.....	—	.....
Shellac, V. S. O.....	lb.	.....	—	.....
Shellac, Diamond I.....	lb.	.....	—	.....
Shellac, orange, fine.....	lb.	1.05	—	.....
Shellac, orange, superfine.....	lb.	1.10	—	1.30
Shellac, A.C. garnet.....	lb.	1.00	—	.....
Shellac, bleached, bone dry.....	lb.	1.25	—	.....
Shellac, bleached, fresh ground.....	lb.	1.20	—	.....
Soapstone.....	ton	15.00	—	25.00
Talc, domestic.....	ton	16.00	—	60.00
Talc, imported.....	ton	55.00	—	60.00

Refractories

Following prices are f.o.b. works:

Chrome brick.....	net ton	80-90 at Chester, Penn.
Chrome cement.....	net ton	45-50 at Chester, Penn.
Clay brick, 1st quality fireclay.....	net ton	35-45 at Clearfield, Penn.
Clay brick, 2nd quality.....	net ton	30-35 at Clearfield, Penn.
Magnesite, dead burned.....	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4 1/2 x 2 1/2 in.....	net ton	80-90 at Chester, Penn.
Silica brick.....	net ton	41-45 at Mt. Union, Penn.

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon.....	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon.....	lb.	.70	—	
Ferro-manganese, 70-80% Mn.....	gross ton	105.00	—	115.00
Spiegeleisen, 16-20% Mn.....	gross ton	35.00	—	36.00
Ferro-molybdenum, per lb. of Mo.....	lb.	2.50	—	3.00
Ferro-silicon, 50%.....	gross ton	85.00	—	95.00
Ferro-silicon, 75%.....	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%.....	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.....	lb.	1.25	—	1.40
Ferro-uranium, 35-50%, of U.....	lb.	7.00	—	
Ferro-vanadium, 30-40% per lb. of contained V.....	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40%, Cr ₂ O ₃	unit	\$0.60	—	\$0.80
Chrome ore, 48% and over.....	unit	.90	—	1.00
Coke, foundry, f.o.b. ovens.....	net ton	6.50	—	7.00
Coke, furnace, f.o.b. ovens.....	net ton	5.00	—	5.50
Petroleum coke, refinery, Atlantic seaboard.....	net ton	12.00	—	12.50
Fluorspar, gravel, f.o.b. mines.....	net ton	20.00	—	25.00
Manganese ore, 45% Mn and over.....	unit	.50	—	.75
Manganese ore, chemical (MnO ₂).....	gross ton	60.00	—	70.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	9.00	—	15.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃	unit	7.50	—	10.00
Uranium oxide, 96%.....	lb.	.....	—	.....
Vanadium pentoxide, 99%.....	lb.	6.00	—	.....
Pyrites, foreign, lump.....	unit	.13	—	.....
Pyrites, foreign, fine.....	unit	.14	—	.....
Pyrites, domestic, fine.....	unit	.....	—	.17
Ilmenite, 32% TiO ₂ , f.o.b. N. Y.....	net ton	40.00	—	.....
Rutile, 95% TiO ₂ , f.o.b. N. Y.....	net ton	200.00	—	.....
Carnotite, minimum 2% U ₂ O ₅ , per lb. of U ₂ O ₅	lb.	2.75	—	3.00
Zircon, washed, iron free, f.o.b. N. Y.....	net ton	.....	—	.....
Monazite, per unit of ThO ₂ , f.o.b. N. Y.....	unit	42.00	—	.....

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags.....	bbl.	\$2.80	—	
Lump lime, common, including container.....	300 bbl.	2.65	—	
Common brick, at dock.....	M.	16.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under.....	M.	48.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago.....	M.	50.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis.....	M.	40.00	—	
Roofings, tar felt (14 lb. per 100 sq. ft.).....	ton	60.00-70.00	—	
Roofings, tar pitch (in 400-lb. bbl.) carlots.....	ton	21.00	—	
Roofings, asphalt pitch carlots.....	ton	34.00	—	
Roofings, asphalt felt carlots.....	ton	63.00	—	
Roofings, slate-surfaced, per roll of 108 sq. ft. carlots.....	ton	2.25	—	
Roofings, slate-finished shingles, 100 sq. ft. carlots.....	ton	6.00	—	
Linseed oil, raw in barrels.....	gal.	1.75	—	
Linseed oil, 5 gal. cans.....	gal.	1.90	—	
Red lead, dry, 100 lb. keg.....	lb.	.13	—	
Red lead, in oil, 100 lb. keg.....	lb.	.14	—	
Red lead, dry, 5 lb. cans.....	lb.	.15	—	
Red lead, in oil, 5 lb. cans.....	lb.	.16	—	
White lead, dry and in oil, 100 lb. keg.....	lb.	.13	—	
White lead, dry and in oil, 25 and 50 lb. kegs.....	lb.	.13	—	
White lead, dry and in oil, 5 lb. cans.....	lb.	.15	—	

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.....	100 lb.	\$2.45	—	
Angles, 3 to 6-in., 1-in. thick.....	100 lb.	2.45	—	
Tees, 3-in. and larger.....	100 lb.	2.45	—	
Plates.....	100 lb.	2.66	—	
Rivets, structural, 1-in. and larger.....	100 lb.	4.20	—	
Rivets, conehead for boilers, 1-in. and larger.....	100 lb.	4.30	—	
Sheets, No. 28 black.....	100 lb.	4.35	—	
Sheets, No. 10 blue annealed.....	100 lb.	3.54	—	
Sheets, No. 28 galvanized.....	100 lb.	.....	—	.....

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; for galvanized corrugated sheets, add 15c., all gages.

Current Market Reports

The Non-Ferrous Metal Market

Friday, Nov. 7.—The market continues quiet. Consumers are not taking on supplies at present prices.

Aluminum:—The price fixed during the war still continues. Consumers' supplies are still short. Ingots of 98-99 per cent are quoted at 33c. lb. Sheets, 18 gage and heavier, 42c. Powder, \$.70-\$1.40 lb.

Antimony:—Strong at 9-9½c. lb.

Copper:—A featureless market with price tending to descend.

	Cents per Lb.
Copper, lake.....	21.50
Copper, electrolytic.....	21.00
Copper, casting.....	20.00
Copper sheets, hot-rolled.....	32.50
Copper sheets, cold rolled.....	35.50
Copper bottoms.....	40.50
Copper rods.....	28.00
Copper wire.....	25.75
High brass wire and sheets.....	26.75
High brass rods.....	24.75
Low brass wire and sheets.....	29.50
Low brass rods.....	30.25
Brass tubing.....	38.00
Seamless copper tubing.....	43.25
Seamless brass tubing.....	35.50
Seamless bronze tubing.....	39.75
Seamless brass tubing.....	34.00
Bronze (gold) powder.....	100.00

Lead:—There is less activity. New York quotes from 6.75 to 6.90c. lb., and St. Louis 6.50c.

Tin:—Sales at 54½c. are reported, but important activity cannot be expected before shipping becomes normal.

Zinc:—There is a strong tone to the zinc market. New York quotes 8c. and East St. Louis 7.70c.

OTHER METALS

Bismuth.....	lb.	\$3.20 — \$3.65
Cadmium.....	lb.	1.40 —
Cobalt.....	lb.	2.50 — 3.50
Magnesium.....	lb.	1.75 — 2.10
Mercury.....	75 lb.	90.00 — 100.00
Nickel.....	lb.	.40 — .45
Iridium.....	oz.	175.00 —
Palladium.....	oz.	120.00 — 121.00
Platinum.....	oz.	130.00 — 135.00
Silver.....	oz.	1.23½ —

The Iron and Steel Market

In the eighth week of the iron and steel strike the production of steel may be estimated at approximately 70 per cent of the rate obtaining just before the strike, this comparing with a rate of about 50 per cent when the strike was at its height. It should be noted, however, that production just before the strike, while at the highest rate of the year since February, was at only between 80 and 85 per cent of capacity. On the complete ending of the strike, as a strike, the total of working forces in the industry is likely to be less than before the strike, rather than more, since strike breakers have been employed to but a slight extent, while some men have gone back to the countries of their birth. Apart from the matter of numbers, working forces are more or less disorganized and will be for some time to come, so many men having shifted their employment. Restricted production is a prospect giving some of the manufacturers more concern than the loss in tonnage during the strike. During the strike customers are co-operative and sympathetic, while after the strike they are likely to be strenuous in their demands for deliveries.

The Wheeling district remains closed almost completely, but the Mahoning Valley is making substantial and moderately rapid recovery from its complete closing, production in the valley being now about 25 per cent of normal. The Chicago-Gary district has easily crossed the 50 per cent line, while Cleveland and Buffalo continue to gain. The South continues working in full, with the Ensley steel plant producing at above rated capacity, while the East is almost free from strike.

PIG IRON ADVANCES

Following sharp advances in eastern Pennsylvania and along the lake front, the western Pennsylvania and valley pig iron market shows a strong advancing tendency, but in that region the advances are not clear cut. There is

the phenomenon of sales of prompt iron being made at large advances, with the furnaces refusing to quote for 1920 deliveries, whereby the only market that exists, in actual transactions, shows a large advance and yet it is not certain that buyers would pay any considerably advanced prices for the extended deliveries.

Prices are now approximately as follows: F.o.b. valley furnaces: Bessemer, \$28 to \$29; basic, \$27 to \$28; foundry, \$29 to \$32; No. 2X foundry, delivered Philadelphia, \$34.10 to \$35.10; No. 2X foundry, Buffalo furnace, \$32 to \$33; foundry, delivered Cleveland, \$29.15 to \$31.15; foundry, f.o.b. Birmingham furnaces, \$29 to \$30.

The Chemical Market

New York, November 10, 1919.

While there is a fair volume of buying of heavy chemicals for immediate requirements, dealers are devoting most of their attention to the removal of their goods from ships that have been lying in the harbor for several weeks and to arranging for export shipments. The only added feature of the tight situation in coal-tar products is the recently developed foreign inquiry. There has been no particular interest in vegetable oils, due in great measure to the wide difference between sellers' and buyers' views. Prices on these oils as well as fish oils remain practically unchanged. An unprecedented demand for all grades of paraffine waxes has suddenly arisen both in domestic and export circles. All leading refiners have their output for the remainder of the year sold, some being sold up through the greater part of February. The wax market has been sluggish for some time, but this sudden activity on the part of paraffines has imparted life to the remainder of the list, although no price increases, excepting on paraffines, are announced. While cable advices are unsatisfactory, it is the general belief that Calcutta is short of supplies of shellac. In addition crop reports are very unsatisfactory. All indications, therefore, point to higher prices. There are still no spot supplies of the better grades of rosins available, such as WW, WG, H and I, or spirits of turpentine. Para and plantation grades of rubber have displayed opposite tendencies during the week. Manufacturers and dealers have shown an active interest in plantations for both spot goods and future deliveries. Quotations for spot and future have been on about the same level. Under the improved shipping conditions premiums are no longer being offered for spot goods. First latex crepe is quoted at 55c. per lb.

HEAVY CHEMICALS

Plenty of inquiries for heavy chemicals are running the gamut of the market at present, but the prices bid are below the dealers' figures. Manufacturers, whenever they can spare any of their output from contracts, are holding their products at high levels. A shortage of steel drums is beginning to be felt.

Sodium bichromate was the feature of the market during the week. The price jumped from 12½c. per lb. to 14½-15c. Heavy producers withdrew further offerings at 12½c., but there appears to be few odd lots in second hands. With the arrival of a heavy shipment of Norwegian **sodium nitrite**, a slight decrease in price on this article, now selling around 14c. per lb., is expected.

The extreme scarcity of **formaldehyde** has caused it to exceed all previous price levels. The few dealers who have any goods are asking 30c. per lb. A heavy tonnage of both **caustic soda** and **ammonium sulphate** has been sold to Japan at regular export prices. In domestic trading caustic soda has been slow. **Denatured alcohol** could not be obtained during the week and prices are nominal.

COAL-TAR PRODUCTS

Business in this field has been greatly accelerated by the large number of export inquiries, **alpha-naphthylamine** being slightly in the lead. While South America has placed some orders for this product, Japan has bought large quantities. **Ortho-toluidine** and **toluidine** are also in good request. While the orders for toluidine only average from 500-1000 lb. in quantity, the demand is steady.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, NOV. 10, 1919

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0.60—\$0.65
Acetone.....lb.	\$0.13—\$0.14	15—15½
Acetic, 26 per cent.....cwt.	2.50—2.65	3.00—3.25
Acetic, 56 per cent.....cwt.	5.00—5.50	6.00—6.50
Acetic, glacial, 99½ per cent, carboys.....cwt.	12.00—12.50	12.90—13.50
Boric, crystals.....lb.	12—13½	13½—14
Boric, powder.....lb.	12—13½	13½—14
Hydrochloric, (muriatic) tech. 20 deg.....cwt.	1.50—1.75	2.00—2.50
Hydrofluoric, 52 deg.....lb.	12—14	14—16
Lactic, 44 per cent. tech.....lb.	11—14	12—16
Lactic, 22 per cent. tech.....lb.	05—06	05½—07
Molybdic, C. P.....lb.		4.00—4.25
Nitric, 40 deg.....lb.	06—06½	07—08½
Nitric, 42 deg.....lb.	07—07½	08—08½
Oxalic, crystals.....lb.	22—24	25—30
Phosphoric, Ortho, 50 per cent. solution.....lb.	10—11	11—14
Picric.....lb.	30—35	40—50
Pyrogallol, resublimed.....lb.		2.30—2.60
Sulphuric, 60 deg., tank cars.....ton	12.00—16.00	22.00—
Sulphuric, 60 deg., drums.....ton	17.00—	25.00—
Sulphuric, 60 deg., carboys.....ton	20.00—	25.00—
Sulphuric, 66 deg., tank cars.....ton	17.00—18.00	22.00—23.00
Sulphuric, 66 deg., drums.....ton	20.00—21.00	25.00—26.00
Sulphuric, 66 deg., carboys.....ton	25.00—	30.00—40.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars.....ton	20.00—	26.00—
Sulphuric, fuming, 20 per cent. (oleum) drums.....ton	25.00—	32.00—
Sulphuric, fuming, 20 per cent. (oleum) carboys.....ton	30.00—	35.00—
Tannic, U. S. P.....lb.		1.35—1.45
Tannic (tech.).....lb.		42—55
Tartaric, crystals.....lb.		72—73
Tungstic, per lb. of WO.....lb.		1.20—1.40
Alcohol, Ethyl.....gal.	4.90—	4.95—
Alcohol, Methyl.....gal.	1.30—	1.33—1.38
Alcohol, denatured, 188 proof.....gal.	58—60	60—64
Alcohol, denatured, 190 proof.....gal.	54—56	56—60
Alum, ammonia lump.....lb.	03½—04½	04½—04½
Alum, potash lump.....lb.	07½—08½	09—09½
Alum, chrome lump.....lb.	15—16	18—20
Aluminum sulphate, commercial.....lb.	01½—02	02½—02½
Aluminum sulphate, iron free.....lb.	02½—03	03½—03½
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	08—	08½—08½
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.		30—35
Ammonium carbonate, powder.....lb.	13—13½	14—14½
Ammonium chloride, granular (white sal-ammoniac).....lb.	12½—13	13½—14
Ammonium chloride, granular (gray sal-ammoniac).....lb.	12—12½	13—13½
Ammonium nitrate.....lb.	10—	11—12
Ammonium sulphate.....lb.	05—	06—
Amyl acetate.....gal.		3.65—3.75
Arsenic, oxide, lumps (white arsenic).....lb.		10½—11
Arsenic, sulphide, powdered (red arsenic).....lb.		10½—11
Barium chloride.....ton	85.00—	90.00—100.00
Barium dioxide (peroxide).....lb.	22—	24—
Barium nitrate.....lb.	10—10½	11—12
Barium sulphate (precip.) (blanc fixe).....lb.	03—03½	03½—04
Bleaching powder (see calcium hypochlorite).....		
Blue Vitriol (see copper sulphate).....		
Borax (see sodium borate).....		
Brimstone (see sulphur, roll).....		
Bromine.....lb.		65—75
Calcium acetate.....cwt.	2.00—2.05	2.10—
Calcium carbide.....lb.		04½—05
Calcium chloride, fused, lump.....ton	19.00—25.00	30.00—40.00
Calcium chloride, granulated.....lb.	01½—01½	02—02½
Calcium hypochlorite (bleaching powder).....cwt.	2.25—2.50	2.75—
Calcium peroxide.....lb.		1.50—1.70
Calcium phosphate, monobasic.....lb.		09—09½
Calcium sulphate, precipitated.....lb.		06½—07
Carbon bisulphide.....lb.	06—	06½—
Carbon tetrachloride, drums.....lb.	10—11	12—14
Carbonyl chloride (phosgene).....lb.		75—
Caustic potash (see potassium hydroxide).....		
Caustic soda (see sodium hydroxide).....		
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	05—05½	1.50—1.55
Cobalt oxide.....lb.		1.50—1.55
Copperas (see iron sulphate).....		
Copper carbonate, green precipitate.....lb.		28—31
Copper cyanide.....lb.		65—70
Copper sulphate, crystals.....lb.	08½—08½	09—09½
Cream of tartar (see potassium bitartrate).....		
Epsom salt (see magnesium sulphate).....		
Formaldehyde, 40 per cent.....lb.		27—30
Glauber's salt (see sodium sulphate).....		
Glycerine.....lb.		20½—21
Iodine, resublimed.....lb.		4.50—
Iron oxide, red.....lb.		03—20
Iron sulphate, (copperas).....cwt.	1.00—	1.20—1.50
Lead acetate, normal.....lb.		12½—14½
Lead arsenate (paste).....lb.		13—17
Lead nitrate, crystals.....lb.		85—86½
Litharge.....lb.		09½—10½
Lithium Carbonate.....lb.		50—
Magnesium carbonate, technical.....lb.		13—14½
Magnesium sulphate, U. S. P.....100 lb.	2.00—2.65	2.75—3.00
Magnesium sulphate, commercial.....100 lb.	1.75—	2.00—2.50
Nickel salt, double.....lb.	14—	15—
Nickel salt, single.....lb.	12—	15—16
Phosgene (see carbonyl chloride).....		
Phosphorus, red.....lb.		60—70
Phosphorus, yellow.....lb.		35—37
Potassium bichromate.....lb.	25½—26	
Potassium bitartrate (cream of Tartar).....lb.		55—60
Potassium bromide, granular.....lb.		75—
Potassium carbonate, U. S. P.....lb.	55—	60—65
Potassium carbonate, crude.....lb.	25—	28—
Potassium chlorate, crystals.....lb.	18—20	21—
Potassium cyanide, 98-99 per cent.....nominal		
Potassium hydroxide (caustic potash).....lb.	25—28	30—31
Potassium iodide.....lb.		3.55—3.60
Potassium nitrate.....lb.	19—	21—
Potassium permanganate.....lb.		52—60
Potassium prussiate, red.....lb.		1.05—1.15

	Carlots	Less Carlots
Potassium prussiate, yellow.....lb.		.40—
Potassium sulphate.....ton	225.00—	.44—
Rochelle salts (see sodium potas. tartrate).....		
Salammoniac (see ammonium chloride).....		
Salt soda (see sodium carbonate).....		
Salt cake (sodium sulphate).....ton	17.90—21.00	
Silver cyanide.....oz.		1.19—
Silver nitrate.....oz.		.75½—
Soda ash, light.....100 lb.	1.90—	2.00—2.05
Soda ash, dense.....100 lb.	2.25—2.35	2.50—2.75
Sodium acetate.....lb.	06½—07	07½—08
Sodium bicarbonate.....100 lb.	2.35—	2.75—3.00
Sodium bichromate.....lb.	14—14½	15—
Sodium bisulphate (nitre cake).....ton	3.00—8.00	10.00—
Sodium bisulphite.....cwt.	1.80—1.90	2.00—2.10
Sodium borate (borax).....lb.	07½—	08—08½
Sodium carbonate (sal soda).....100 lb.	1.35—1.50	1.50—1.75
Sodium chlorate.....lb.	15—	16—18½
Sodium cyanide.....lb.	30—	31—34
Sodium fluoride.....lb.	14—	15—16
Sodium hydroxide (caustic soda).....100 lb.	3.30—3.40	3.45—3.50
Sodium molybdate.....lb.	2.50—	3.25—
Sodium nitrate.....100 lb.	2.87½—3.25	3.75—4.00
Sodium nitrite.....lb.	14—17	18—
Sodium peroxide, powdered.....lb.		30—32
Sodium phosphate, dibasic.....lb.	03½—04	04½—05
Sodium potassium tartrate (Rochelle salts).....lb.		43—45½
Sodium prussiate, yellow.....lb.	25—26	27—28
Sodium silicate, solution (40 deg.).....lb.	01½—02	02—02½
Sodium silicate, solution (60 deg.).....lb.	02½—03	03½—04½
Sodium sulphate, crystals (Glauber's salts) cwt.	1.15—1.25	1.50—2.00
Sodium sulphide, crystal, 60-62 per cent. (conc).....lb.		05—06
Sodium sulphite, crystals.....lb.	03½—	04—06
Strontium nitrate, crystals.....lb.	25—	28—
Sulphur chloride.....lb.	05½—	06—
Sulphur, crude.....ton	22.00—	
Sulphur dioxide, liquid, cylinders.....lb.		10—12
Sulphur (sublimed), flour.....100 lb.	3.10—	3.40—3.65
Sulphur, roll (brimstone).....100 lb.	2.95—	3.15—3.40
Tin bichloride (stannous).....lb.	44—	46—50
Tin oxide.....lb.		60—
Zinc carbonate, precipitate.....lb.		20—
Zinc chloride, gran.....lb.	12½—	13½—14
Zinc cyanide.....lb.	49—	50—
Zinc dust.....lb.	09—11	11—14
Zinc oxide, dry American.....lb.		09½—09½
Zinc sulphate.....lb.	03½—03½	04—04½

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.00—	\$1.10
Alpha naphthol, refined.....lb.	1.40—	1.50
Alpha naphthylamine.....lb.	.35—	.38
Aniline oil, drums extra.....lb.	.34—	.42
Aniline salts.....lb.	.90—	1.00
Anthracene, 80% in drums (100 lb.).....lb.	1.00—	1.15
Benzaldehyde (f.f.c.).....lb.	1.00—	1.25
Benzidine, base.....lb.	.90—	1.15
Benzidine, sulphate.....lb.	.90—	1.10
Benzoic acid, U. S. P.....lb.	.85—	1.10
Benzoate of soda, U. S. P.....lb.	.36—	.40
Benzol, pure, water-white, in drums (100 lb.).....gal.	.24—	.28
Benzol, 90% in drums (100 lb.).....lb.	.35—	.40
Benzyl chloride, 95-97%, refined.....lb.	.25—	.35
Benzyl chloride, tech.....lb.	.75—	.80
Beta naphthol benzoate.....lb.	3.75—	4.50
Beta naphthol, sublimed.....lb.	.75—	.80
Beta naphthol, tech.....lb.	.47—	.55
Beta naphthylamine, sublimed.....lb.	2.25—	2.35
Cresol, U. S. P., in drums (100 lb.).....lb.	.18—	.25
Ortho-cresol, in drums (100 lb.).....lb.	.23—	.25
Cresylic acid, 97-99%, straw color, in drums.....gal.	.80—	.85
Cresylic acid, 95-97%, dark, in drums.....gal.	.85—	.90
Cresylic acid, 50%, first quality, drums.....gal.	.60—	.70
Dichlorobenzol.....lb.	.07—	.10
Diethylaniline.....lb.	1.40—	2.25
Dimethylaniline.....lb.	.58—	.63
Dinitrobenzol.....lb.	.27—	.37
Dinitrochlorobenzol.....lb.	.25—	.30
Dinitronaphthalene.....lb.	.45—	.55
Dinitrophenol.....lb.	.33—	.36
Dinitrotoluol.....lb.	.38—	.45
Dip oil, 25%, tar acids, car lots, in drums.....gal.	.38—	.65
Diphenylamine.....lb.	.58—	.75
H-acid.....lb.	1.55—	1.70
Metaphenylenediamine.....lb.	1.10—	1.25
Monochlorobenzol.....lb.	.12—	.15
Monooethylaniline.....lb.	1.50—	1.75
Naphthalene crushed, in bbls. (250 lb.).....lb.	.06—	.08
Naphthalene, flake.....lb.	.06½—	.07½
Naphthalene, balls.....lb.	.08½—	.10
Naphthionic acid, crude.....lb.	.75—	1.25
Nitrobenzol.....lb.	.14—	.19
Nitro-naphthalene.....lb.	.35—	.45
Nitro-toluol.....lb.	.40—	.50
Ortho-amidophenol.....lb.	3.75—	4.25
Ortho-dichlor-benzol.....lb.	.15—	.20
Ortho-nitro-phenol.....lb.	.90—	1.25
Ortho-nitro-toluol.....lb.	.25—	.40
Ortho-toluidine.....lb.	.25—	.32
Para-amidophenol, base.....lb.	2.75—	3.50
Para-amidophenol, HCl.....lb.	2.75—	3.25
Para-dichlor-benzol.....lb.	.15—	.18
Paranitraniline.....lb.	1.10—	1.20
Para-nitro-toluol.....lb.	1.35—	1.50
Paraphenylenediamine.....lb.	2.50—	3.00
Paratoluidine.....lb.	1.75—	2.05
Phthalic anhydride.....lb.	1.00—	1.50
Phenol, U. S. P., drums (dest.), (240 lb.).....lb.	.16—	.17
Pyridin.....gal.	2.50—	
Resorcin, technical.....lb.	3.50—	3.75
Resorcin, pure.....lb.	6.50—	6.75
Salicylic acid, tech., in bbls. (110 lb.).....lb.	.45—	.50
Salicylic acid, U. S. P.....lb.	.50—	.55
Salol.....lb.	.90—	.95
Solvent naphtha, water-white, in drums, 100 gal. gal.	.20—	.27
Solvent naphtha, crude, heavy, in drums, 100 gal. gal.	.18—	.24
Sulphanilic acid, crude.....lb.	.25—	.30

Tolidine.....	lb.	\$1.70	—	\$2.50
Toluidine, mixed.....	lb.	.45	—	.55
Toluol, in tank cars.....	gal.	.26	—	.27
Toluol, in drums.....	gal.	.27	—	.30
Xylidine, drums, 100 gal.....	lb.	.44	—	.50
Xylol, pure, in drums.....	gal.	.35	—	.45
Xylol, pure, in tank cars.....	gal.	.23	—	.27
Xylol, commercial, in drums, 100 gal.....	gal.	.23	—	.27
Xylol, commercial, in tank cars.....	gal.	.22	—	.25

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow.....	lb.	\$0.41	—	\$0.43
Beeswax, refined, yellow.....	lb.	.47	—	.48
Beeswax, white pure.....	lb.	.64	—	.66
Carnauba, No. 1.....	lb.	.85	—	.88
Carnauba, No. 2, regular.....	lb.	.73	—	.78
Carnauba, No. 3, North Country.....	lb.	.48	—	.50
Japan.....	lb.	.19	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb.	.06	—	.07
Paraffine waxes, crude, scale 124-126 m.p.....	lb.	.06	—	.07
Paraffine waxes, refined, 118-120 m.p.....	lb.	.08	—	.08
Paraffine waxes, refined, 128-130 m.p.....	lb.	.09	—	.09
Paraffine waxes, refined, 133-135 m.p.....	lb.	.10	—	.11
Paraffine waxes, refined, 135-137 m.p.....	lb.	.12	—	.13
Stearic acid, single pressed.....	lb.	.26	—	.28
Stearic acid, double pressed.....	lb.	.28	—	.29
Stearic acid, triple pressed.....	lb.	.32	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940.....	gal.	\$1.10	—	
Pine oil, pure, dest. dist.....	gal.	.96	—	
Pine tar oil, ref., sp. gr. 1.025-1.035.....	gal.	.45	—	
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.34	—	
Pine tar oil, double ref., sp. gr. 0.965-0.990.....	gal.	.65	—	
Pine tar, ref., thin, sp. gr. 1.080-1.060.....	gal.	.38	—	
Turpentine, crude, sp. gr. 0.900-0.970.....	gal.	.85	—	
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990.....	gal.	.30	—	
Pinewood creosote, ref.....	gal.	.48	—	

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.....	280 lb.	\$17.50	—	\$20.00
Rosin E-I.....	280 lb.	17.75	—	20.00
Rosin K-N.....	280 lb.	20.25	—	22.50
Rosin W. G. W. W.....	280 lb.	23.25	—	24.30
Wood rosin, bbl.....	280 lb.	16.50	—	17.00
Spirits of turpentine.....	gal.	1.70	—	
Wood turpentine, steam dist.....	gal.	1.50	—	
Wood turpentine, dest. dist.....	gal.	1.48	—	
Pine tar pitch, bbl.....	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.).....	bbl.	13.50	—	14.25
Retort tar, bbl.....	280 lb.	14.50	—	14.90
Rosin oil, first run.....	gal.	.88	—	.91
Rosin oil, second run.....	gal.	.88	—	.93
Rosin oil, third run.....	gal.	.95	—	1.10
Rosin oil, fourth run.....	gal.	1.05	—	1.15

Solvents

75-76 deg., steel bbls. (85 lb.).....	gal.	\$0.33	—	
70-72 deg., steel bbls. (85 lb.).....	gal.	.31	—	
68-70 deg., steel bbls. (85 lb.).....	gal.	.30	—	
V. M. and P. naphtha, steel bbls. (85 lb.).....	gal.	.23	—	

Crude Rubber

Para-Upriver fine.....	lb.	\$0.51	—	\$0.52
Upriver coarse.....	lb.	.33	—	.35
Upriver caucho ball.....	lb.	.34	—	.35
Plantation—First latex crepe.....	lb.	.55	—	.60
Ribbed smoked sheets.....	lb.	.54	—	.58
Brown crepe, thin, clean.....	lb.	.47	—	.49
Amber crepe No. 1.....	lb.	.52	—	

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.....	lb.	\$0.18	—	\$0.19
Castor oil, AA, in bbls.....	lb.	.21	—	.22
China wood oil, in bbls.....	lb.	.22	—	.23
Cocoonut oil, Ceylon grade, in bbls.....	lb.	.18	—	.18
Cocoonut oil, Cochinchina grade, in bbls.....	lb.	.19	—	.20
Corn oil, crude, in bbls.....	lb.	.18	—	.18
Cottonseed oil, crude (f.o.b. mill).....	lb.	.19	—	.20
Cottonseed oil, summer yellow.....	lb.	.23	—	.24
Cottonseed oil, winter yellow.....	lb.	.24	—	.25
Linseed oil, raw, car lots.....	gal.	1.70	—	1.75
Linseed oil, raw, tank cars.....	gal.	1.65	—	1.70
Linseed oil, boiled, car lots.....	gal.	1.70	—	1.72
Olive oil, commercial.....	gal.	2.40	—	2.50
Palm, Lagos.....	lb.	.17	—	.17
Palm, bright red.....	lb.	.16	—	.17
Palm, Niger.....	lb.	.16	—	.17
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.22	—	.23
Peanut oil, refined, in bbls.....	lb.	.26	—	.27
Rapeseed oil, refined in bbls.....	gal.	1.50	—	1.60
Rapeseed oil, blown, in bbls.....	gal.	1.67	—	1.70
Soya bean oil (Manchurian), in bbls., N. Y.....	lb.	.17	—	.18
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.16	—	.16

FISH

Winter pressed Menhaden.....	gal.	\$1.20	—	
Yellow bleached Menhaden.....	gal.	1.23	—	
White bleached Menhaden.....	gal.	1.25	—	
Blown Menhaden.....	gal.	1.30	—	

Miscellaneous Materials

All Prices f.o.b., N. Y.

Sarytes, domestic, white, floated.....	ton	\$25.00	—	\$36.00
Sarytes, off color.....	ton	20.00	—	25.00
Blanc fixe, dry.....	lb.	.03	—	.04
Blanc fixe, pulp.....	ton	35.00	—	47.50
Casoin.....	lb.	.16	—	.18
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.04	—	.06

Chalk, English, dense.....	lb.	\$.04	—	\$.05
China clay (Kaolin), imported, lump.....	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered.....	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump.....	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered.....	ton	25.00	—	40.00
Fel-lapar.....	ton	12.00	—	16.00
Fluorspar, acid grade, lump, f.o.b. mines.....	net ton	30.00	—	35.00
Fluorspar, acid grade, ground, f.o.b. mines.....	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered.....	ton	25.00	—	30.00
Fuller's earth, imported, powdered.....	ton	35.00	—	40.00
Pumice stone, imported.....	lb.	.03	—	.06
Pumice stone, domestic.....	lb.	.02	—	.03
Shellac, T.N.....	lb.	1.10	—	1.13
Shellac, D. C.....	lb.		—	
Shellac, V. S. O.....	lb.		—	
Shellac, Diamond L.....	lb.		—	
Shellac, orange, fine.....	lb.	1.05	—	
Shellac, orange, superfine.....	lb.	1.20	—	1.30
Shellac, A. C. garnet.....	lb.	1.00	—	
Shellac, bleached, bone dry.....	lb.	1.25	—	
Shellac, bleached, fresh ground.....	lb.	1.20	—	
Sospetone.....	ton	15.00	—	25.00
Talc, domestic.....	ton	16.00	—	60.00
Talc, imported.....	ton	60.00	—	70.00

Refractories

Following prices are f.o.b. works:

Chrome brick.....	net ton	80-90 at Chester, Penn.		
Chrome cement.....	net ton	45-50 at Chester, Penn.		
Clay brick, 1st quality fireclay.....	net ton	35-45 at Clearfield, Penn.		
Clay brick, 2nd quality.....	net ton	30-35 at Clearfield, Penn.		
Magnesite, dead burned.....	net ton	50-55 at Chester, Penn.		
Magnesite brick, 9 x 4 1/2 x 2 1/2 in.....	net ton	60-70 at Chester, Penn.		
Silica brick.....	net ton	41-45 at Mt. Union, Penn.		

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon.....	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon.....	lb.	.70	—	
Ferro-manganese, 70-80% Mn.....	gross ton	105.00	—	115.00
Spiegel Eisen, 16-20% Mn.....	gross ton	35.00	—	36.00
Ferro-molybdenum, per lb. of Mo.....	lb.	2.50	—	3.00
Ferro-silicon, 50%.....	gross ton	85.00	—	95.00
Ferro-silicon, 75%.....	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%.....	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.....	lb.	1.25	—	1.40
Ferro-uranium, 35-50%, of U.....	lb.	7.00	—	
Ferro-vanadium, 30-40% per lb. of contained V.....	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40% Cr ₂ O ₃	unit	\$0.60	—	\$0.80
Chrome ore, 48% and over.....	unit	.90	—	1.00
Coke, foundry, f.o.b. ovens.....	net ton	6.50	—	7.00
Coke, furnace, f.o.b. ovens.....	net ton	5.00	—	5.50
Petroleum coke, refinery, Atlantic seaboard.....	net ton	12.00	—	12.50
Fluorspar, gravel, f.o.b. mines.....	net ton	20.00	—	25.00
Manganese ore, 45% Mn and over.....	unit	.50	—	.75
Manganese ore, chemical (MnO ₂).....	gross ton	60.00	—	70.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	9.00	—	15.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃	unit	7.50	—	10.00
Uranium oxide, 98%.....	lb.		—	
Vanadium pentoxide, 99%.....	lb.	6.00	—	
Pyrites, foreign, lump.....	unit	.13	—	
Pyrites, foreign, fine.....	unit	.13	—	
Pyrites, domestic, fine.....	unit	.14	—	.17
Ilmenite, 52% TiO ₂ , f.o.b. N. Y.....	net ton	40.00	—	
Rutile, 95% TiO ₂ , f.o.b. N. Y.....	net ton	220.00	—	
Carnotite, minimum 2% U ₃ O ₈ , per lb. of U ₃ O ₈	lb.	2.75	—	3.00
Zircon, washed, iron free, f.o.b. N. Y.....	net ton	200.00	—	
Monazite, per unit of ThO ₂ , f.o.b. N. Y.....	unit	42.00	—	

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags.....	bbl.	\$2.80		
Lump lime, common, including container.....	300 bbl.	2.65		
Common brick, at dock.....	M.	16.00		
Yellow pine, 3x4 to 8x8, 20 ft. and under.....	M.	48.00		
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago.....	M.	50.00		
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis.....	M.	40.00		
Roofings, tar felt (14 lb. per 100 sq. ft.).....	ton	70.00		
Roofings, tar pitch (in 400-lb. bbl.) carlots.....	ton	21.00		
Roofings, asphalt pitch carlots.....	ton	34.00		
Roofings, asphalt felt carlots.....	ton	63.00		
Roofings, slate-surfaced, per roll of 108 sq. ft. carlots.....		2.25		
Roofings, slate-finished shingles, 100 sq. ft. carlots.....		6.00		
Linseed oil, raw in barrels.....	gal.	1.75		
Linseed oil, 5 gal. cans.....	gal.	1.90		
Red lead, dry, 100 lb. keg.....	lb.	.13		
Red lead, in oil, 100 lb. keg.....	lb.	.14		
Red lead, dry, 5 lb. cans.....	lb.	.15		
Red lead, in oil, 5 lb. cans.....	lb.	.16		
White lead, dry and in oil, 100 lb. keg.....	lb.	.13		
White lead, dry and in oil, 25 and 50 lb. kegs.....	lb.	.13		
White lead, dry and in oil, 5 lb. cans.....	lb.	.15		

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.....	100 lb.	\$2.45		
Angles, 3 to 6-in., 1-in. thick.....	100 lb.	2.45		
Tees, 3-in. and larger.....	100 lb.	2.45		
Plates.....	100 lb.	2.66		
Rivets, structural, 1-in. and larger.....	100 lb.	4.20		
Rivets, conehead for boilers, 1-in. and larger.....	100 lb.	4.30		
Sheets, No. 28 black.....	100 lb.	4.35		
Sheets, No. 10 blue annealed.....	100 lb.	3.55		
Sheets, No. 28 galvanized.....	100 lb.	5.70		

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

Current Market Reports

The Non-Ferrous Metal Market

Friday, Nov. 14.—Conditions are tending to improve, though the market is generally quiet.

Aluminum:—Virgin metal continues to be quoted at 33c. lb. in ingots, 98-99 per cent.

Antimony:—The price is advancing. New York spot quotes 9½-9¾c. lb.

Copper:—Export trade is still featureless.

	Cents per Lb.
Copper, lake.....	21.25
Copper, electrolytic.....	20.00
Copper, casting.....	20.00
Copper sheets, hot-rolled.....	32.50
Copper sheets, cold rolled.....	33.50
Copper bottoms.....	39.50
Copper rods.....	27.00
Copper wire.....	24.75
High brass wire and sheets.....	26.25
High brass rods.....	24.75
Low brass wire and sheets.....	28.75
Low brass rods.....	29.50
Brazed brass tubing.....	38.00
Brazed bronze tubing.....	43.25
Seamless copper tubing.....	34.50
Seamless bronze tubing.....	37.00
Seamless brass tubing.....	33.50
Bronze (gold) powder.....	100.00

Lead:—The market is strong and another advance is expected. New York spot quoted at 6.75-7c. lb., St. Louis, 6.5-6.8c.

Tin:—Imports are quoted at 53¾c. and spot 54¼c.

Zinc:—Export orders for zinc have strengthened the market. Spot New York quoted at 8¼c. and East St. Louis, 7.95-8c. lb.

OTHER METALS

Bismuth..... lb.	\$3.20 — \$3.65
Cadmium..... lb.	1.40 —
Cobalt..... lb.	2.50 — 3.50
Magnesium..... lb.	1.75 — 2.10
Mercury..... 75 lb.	90.00 — 95.00
Nickel..... lb.	.40 — .45
Iridium..... oz.	175.00 —
Palladium..... oz.	135.00 —
Platinum..... oz.	105.00 —
Silver..... oz.	1.29 —

The Iron and Steel Market

The iron and steel strike has ended its eighth week, with a production in that week equal to about 70 per cent of the rate just before the strike. The average operation in the eight weeks may be taken at 58 per cent of the pre-strike rate. Ingot production may be taken, for first three weeks of September, just before the strike, as at the rate of 41,000,000 tons a year. Except for the dislocation caused by the manufacture of shell steel during the war, with its heavy croppings, finished rolled steel has run quite uniformly at 76 per cent of the ingot tonnage. Using this factor, the production of finished rolled steel just before the strike was at the rate of 600,000 gross tons a week. In the eight weeks of strike this would have meant an output of 4,800,000 tons, while at 58 per cent the output was about 2,800,000 tons, showing what might be called a deficit of 2,000,000 tons. There can hardly be much additional deficit, no more than a very few hundred thousand tons. Production will then depend upon the number and efficiency of the men employed. There were deficiencies in both respects before the strike, and the same condition will apply in greater or less degree after the strike.

STEEL MARKET STRONG

While there is no large shortage of steel in point of tonnage, there are some consumers who are very short and are willing to pay substantial premiums for early deliveries. Offerings are so light that a very moderate demand, in point of tonnage, produces the appearance of there being an acute shortage, while in occasional instances very large premiums are offered, the record premium offered being \$30 a ton for automobile body sheets for prompt shipment.

There is no regular market quotable for early deliveries, as each bid or transaction is a case by itself. As to forward deliveries, the United States Steel Corporation's position is unaltered, that it does not approve of there being

any price advances. The deliveries, of course, were all in 1920, as the corporation was already sold up into that year. In sheets and tin plates the corporation has not yet opened its books for the new period, but some reservations are being accepted from regular customers.

PIG IRON ADVANCES

The advance in pig iron continues, the average in the past week being about a dollar a ton. Foundry iron is now quotable as follows for early delivery, there being practically no established market for extended delivery: Delivered Philadelphia, \$35.10; f.o.b. furnace: \$33, Buffalo; \$32, Cleveland; \$32, Chicago; \$30, Birmingham, and \$34, valley. Bessemer and basic pig iron have not participated in the advance to any extent. There have been sales of both grades to gray and malleable iron foundries, as substitutes for malleable or foundry iron, at prices higher than would be paid for steel making or ingot mold purposes. For regular use basic iron has brought \$27.25, valley and bessemer \$28.50.

The foundry iron furnaces are helping the advance by refraining from quoting for extended delivery, and later they may be able to enter the market with the same prices for extended delivery as they are now securing for prompt shipment.

The Chemical Market

New York, November 15, 1919.

There were no unusual features attaching to heavy chemicals during the week. Little can be added to previous statements concerning conditions among coal-tar products. Dimethylaniline is unobtainable in the local market except that here and there an odd lot can be located. The output of alphanaphthylamine from one important source at least is sold a month ahead. Although the vegetable oil market during the week assumed a little strength, there were on the whole few buyers, excepting those who wished to cover on speculations. Crude peanut oil was offered at 23¼c. per lb., f.o.b. Pacific Coast; oleomargarine producers are beginning to enter the market for this oil. One hundred tons of chinawood oil in barrels was offered at 21c. per lb., f.o.b. Pacific Coast for Dec.-Jan. delivery, with tanks offered at the same price. Linseed oil is perceptibly stronger, which is attributable in the main to speculative influences in the flaxseed market. With the distribution of supplies of naval stores made available by the recent termination of the harbor strike to cover previous orders, there is still a scarcity of both spirits of turpentine and rosins. The crude rubber market closed with a steady tone, although it was dull during the greater part of the week. The slight manufacturing interest was on the basis of next year's requirements. There is little activity at present in either ores or ferro-alloys, particularly for export, owing to the adverse exchange situation. Tungsten is in an unsettled state pending the fate of the tariff measure on that ore. Foreign pyrites is still hard pressed because of the high freight rates and the difficulty in chartering steamers for its shipment.

HEAVY CHEMICALS

At the unchanged quotation of 14½-15c sodium bichromate is still the feature of the market. Offerings appearing were quickly absorbed, while producers are attending only to contract deliveries. The export demand is also strong.

Caustic soda and soda ash have reversed positions, the former now receiving the most attention. The bulk of this demand is for export, but the price offered by purchasers is inclined to fall below the Alkali Export Association price. This market, however, is well in the hands of manufacturers and buyers must meet the Association price of \$3.32½ per cwt.

Formaldehyde is still hovering around the record high figure of 30c. per lb. for spot goods, some quarters holding out for 32c. One leading manufacturer, however, endeavoring to eradicate the speculative influences and to give the regular consumer an opportunity to obtain supplies at a reasonable price, adheres to the old level of 19c.

Arsenic, ammonium sulphate and potassium carbonate are very scarce.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, NOV. 15, 1919

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0.60-\$0.65
Acetone.....lb.	\$0.13-\$0.14	.15-.15
Acid, acetic, 28 per cent.....cwt.	2.50-2.65	3.00-3.25
Acetic, 56 per cent.....cwt.	5.00-5.50	6.00-6.50
Acetic, glacial, 99 1/2 per cent, carboys.....cwt.	12.00-12.50	12.90-13.50
Boric, crystals.....lb.	.12-.13	.13-.14
Boric, powder.....lb.	.12-.13	.13-.14
Hydrochloric, (muriatic) tech. 20 deg. cwt.	1.50-1.75	2.00-2.50
Hydrofluoric, 52 deg. lb.	.12-.14	.12-.16
Lactic, 44 per cent, tech. lb.	.11-.14	.05-.07
Lactic, 22 per cent, tech. lb.	.05-.06	4.00-4.25
Molybdenic, C. P. lb.		.07-.08
Nitric, 40 deg. lb.	.06-.06	.08-.08
Nitric, 42 deg. lb.	.07-.07	.08-.08
Oxalic, crystals.....lb.	.22-.24	.25-.30
Phosphoric, Ortho, 50 per cent, solution.....lb.	.10-.11	.11-.14
Picric.....lb.	.30-.35	.40-.50
Pyrogallol, resublimed.....lb.		2.30-2.60
Sulphuric, 60 deg. tank cars.....ton	12.00-16.00	
Sulphuric, 60 deg. drums.....ton	17.00-	22.00-
Sulphuric, 60 deg. carboys.....ton	20.00-	25.00-
Sulphuric, 66 deg. tank cars.....ton	17.00-18.00	22.00-23.00
Sulphuric, 66 deg. drums.....ton	20.00-21.00	25.00-26.00
Sulphuric, 66 deg. carboys.....ton	25.00-	30.00-40.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars.....ton	20.00-	26.00-
Sulphuric, fuming, 20 per cent. (oleum) drums.....ton	25.00-	32.00-
Sulphuric, fuming, 20 per cent. (oleum) carboys.....ton	30.00-	35.00-
Tannic, U. S. P. lb.		1.35-1.45
Tannic (tech.) lb.		.42-.55
Tartaric, crystals.....lb.		.72-.73
Tungstic, per lb. of WO.....lb.		1.20-1.40
Alcohol, Ethyl.....gal.	4.90-	4.95-
Alcohol, Methyl.....gal.	1.40-	1.43-
Alcohol, denatured, 188 proof.....gal.	.58-.60	.60-.64
Alcohol, denatured, 190 proof.....gal.	.54-.56	.56-.60
Alum, ammonia lump.....lb.	.03-.04	.04-.04
Alum, potash lump.....lb.	.07-.07	.08-.09
Alum, chrome lump.....lb.	.15-.16	.18-.20
Aluminum sulphate, commercial.....lb.	.01-.02	.02-.02
Aluminum sulphate, iron free.....lb.	.02-.03	.03-.03
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	.08-	.08-.08
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.		.30-.35
Ammonium carbonate, powder.....lb.	.13-.13	.14-.14
Ammonium chloride, granular (white sal-ammoniac).....lb.	.12-.13	.13-.14
Ammonium chloride, granular (gray sal-ammoniac).....lb.	.12-.12	.13-.13
Ammonium nitrate.....lb.	.10-	.11-.12
Ammonium sulphate.....lb.	.05-	.06-
Amyl acetate.....gal.		3.65-3.75
Arsenic, oxide, lumps (white arsenic).....lb.		.10-.11
Arsenic, sulphide, powdered (red arsenic).....lb.		
Barium chloride.....ton	85.00-	90.00-100.00
Barium dioxide (peroxide).....lb.	.22-	.24-
Barium nitrate.....lb.	.10-.10	.11-.12
Barium sulphate (precip.) (blanc fixe).....lb.	.03-.03	.03-.04
Bleaching powder (see calcium hypochlorite).....lb.		
Blue Vitriol (see copper sulphate).....lb.		
Borax (see sodium borate).....lb.		
Bromine (see sulphur, roll).....lb.		.65-.75
Bromine.....cwt.	2.00-2.05	2.10-
Calcium acetate.....lb.		.04-.05
Calcium carbide.....ton	19.00-25.00	30.00-40.00
Calcium chloride, fused, lump.....lb.	.01-.01	.02-.02
Calcium chloride, granulated.....cwt.	2.25-2.50	.02-.25
Calcium hypochlorite (bleaching powder).....lb.		1.50-1.70
Calcium peroxide.....lb.		.75-.75
Calcium phosphate, monobasic.....lb.		.09-.09
Calcium sulphate, precipitated.....lb.	.06-	.06-.09
Carbon bisulphide.....lb.	.10-.11	.12-.14
Carbon tetrachloride, drums.....lb.		.75-
Carbonyl chloride (phosgene).....lb.		
Caustic potash (see potassium hydroxide).....lb.		
Caustic soda (see sodium hydroxide).....lb.	.05-.05	.08-
Chlorine, gas, liquid-cylinders (100 lb.).....lb.		1.50-1.55
Cobalt oxide.....lb.		.28-.31
Copperas (see iron sulphate).....lb.		.65-.70
Copper carbonate, green precipitate.....lb.		.09-.09
Copper cyanide.....lb.	.08-.08	.08-.08
Copper sulphate, crystals.....lb.		
Cream of tartar (see potassium bitartrate).....lb.		
Epsom salt (see magnesium sulphate).....lb.		
Formaldehyde, 40 per cent.....lb.		.19-.30
Glauber's salt (see sodium sulphate).....lb.		.20-.21
Glycerine.....lb.		4.50-.21
Iodine, resublimed.....lb.		.03-.20
Iron oxide, red.....cwt.	1.00-	1.20-1.50
Iron sulphate, (copperas).....lb.		.12-.14
Lead acetate, normal.....lb.		.15-.17
Lead arsenate (paste).....lb.		.85-.86
Lead nitrate, crystals.....lb.		.09-.10
Litharge.....lb.		.50-.50
Lithium Carbonate.....lb.		.13-.14
Magnesium carbonate, technical.....lb.		2.75-3.00
Magnesium sulphate, U. S. P. 100 lb.	2.00-2.63	2.00-2.50
Magnesium sulphate, commercial 100 lb.	1.75-	.15-.16
Nickel salt, double.....lb.	.14-	
Nickel salt, single.....lb.	.12-	
Phosgene (see carbonyl chloride).....lb.		.60-.70
Phosphorus, red.....lb.		.35-.37
Potassium bichromate.....lb.	.25-.26	
Potassium bitartrate (cream of Tartar).....lb.		.55-.60
Potassium bromide, granular.....lb.		.74-.65
Potassium carbonate, U. S. P. lb.	.55-	.60-.65
Potassium carbonate, crude.....lb.	.23-	.27-
Potassium chlorate, crystals.....lb.	.18-.20	.21-
Potassium cyanide, 98-99 per cent.....lb.	nominal	.30-.31
Potassium hydroxide (caustic potash).....lb.	.25-.28	3.55-3.60
Potassium iodide.....lb.		.21-
Potassium nitrate.....lb.	.19-	.21-
Potassium permanganate.....lb.		.51-.58
Potassium prussiate, red.....lb.		1.05-1.15

	Carlots	Less Carlots
Potassium prussiate, yellow.....lb.		.40-.44
Potassium sulphate.....ton	225.00-	
Rochelle salts (see sodium potas, tartrate).....lb.		
Salammoniac (see ammonium chloride).....lb.		
Salt soda (see sodium carbonate).....ton	17.00-21.00	
Salt cake (sodium sulphate).....ton		
Silver cyanide.....oz.		1.19-
Silver nitrate.....oz.		7.51-.76
Soda ash, light.....100 lb.	1.90-2.05	2.10-
Soda ash, dense.....100 lb.	2.15-2.25	2.30-
Sodium acetate.....lb.	.06-.07	.07-.08
Sodium bicarbonate.....100 lb.	2.35-	2.75-3.00
Sodium bichromate.....lb.	.14-.15	.15-
Sodium bisulphate (nitre cake).....ton	3.00-8.00	10.00-
Sodium bisulphite.....cwt.	1.80-1.90	2.00-2.10
Sodium borate (borax).....lb.	.07-	.08-.08
Sodium carbonate (sal soda).....100 lb.	1.35-1.50	1.50-1.75
Sodium chloride.....lb.	.15-	.16-.18
Sodium cyanide.....lb.	.30-	.31-.34
Sodium fluoride.....lb.	.14-	.15-.16
Sodium hydroxide (caustic soda).....100 lb.	3.35-3.40	3.45-3.50
Sodium molybdate.....lb.	2.50-	3.25-
Sodium nitrate.....100 lb.	2.87-3.25	3.75-4.00
Sodium nitrite.....lb.	.14-.15	.16-.16
Sodium peroxide, powdered.....lb.		.30-.32
Sodium phosphate, dibasic.....lb.	.03-.04	.04-.05
Sodium potassium tartrate (Rochelle salts).....lb.	.25-.26	.27-.28
Sodium prussiate, yellow.....lb.	.02-.02	.02-.02
Sodium silicate, solution (40 deg.).....lb.	.02-.03	.03-.04
Sodium silicate, solution (60 deg.).....lb.	.02-.03	.03-.04
Sodium sulphate, crystals (Glauber's salts) cwt.	1.15-1.25	1.50-2.00
Sodium sulphide, crystal, 60-62 per cent. (cone).....lb.		.05-.06
Sodium sulphite, crystals.....lb.	.03-	.04-.06
Strontium nitrate, crystals.....lb.	.25-	.28-
Sulphur chloride.....lb.	.05-	.06-
Sulphur, crude.....ton	22.00-	
Sulphur dioxide, liquid, cylinders.....lb.		.10-.12
Sulphur (sublimed), flour.....100 lb.	3.10-	3.40-3.65
Sulphur, roll (brimstone).....100 lb.	2.95-	3.15-3.40
Tin bichloride (stannous).....lb.	.44-	.46-.50
Tin oxide.....lb.		.60-.60
Zinc carbonate, precipitate.....lb.	.12-	.13-.14
Zinc chloride, gran.....lb.	.49-	.11-.14
Zinc cyanide.....lb.	.09-.11	.09-.09
Zinc dust.....lb.		.04-.04
Zinc oxide, dry American.....lb.	.03-.03	
Zinc sulphate.....lb.		

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.00-	\$1.10
Alpha naphthol, refined.....lb.	1.40-	1.50
Alpha naphthylamine.....lb.	.35-	.38
Aniline oil, drums extra.....lb.	.34-	.42
Aniline salts.....lb.	.36-	.42
Anthracene, 80% in drums (100 lb.).....lb.	.90-	1.00
Benzaldehyde (f.f.c.).....lb.	1.00-	1.15
Benzidine, base.....lb.	1.10-	1.25
Benzidine, sulphate.....lb.	.95-	1.15
Benzoic acid, U. S. P. lb.	.90-	1.10
Benzoate of soda, U. S. P. lb.	.85-	1.10
Benzol, pure, water-white, in drums (100 lb.).....gal.	.36-	.40
Benzol, 90%, in drums (100 lb.).....gal.	.24-	.28
Benzyl chloride, 95-97%, refined.....lb.	.35-	.40
Benzyl chloride, tech.....lb.	.25-	.35
Beta naphthol benzoate.....lb.	3.75-	4.50
Beta naphthol, sublimed.....lb.	.75-	.80
Beta naphthol, tech.....lb.	.47-	.55
Beta naphthylamine, sublimed.....lb.	2.25-	2.35
Creosol, U. S. P., in drums (100 lb.).....lb.	.18-	.20
Ortho-creosol, in drums (100 lb.).....lb.	.23-	.25
Creosylic acid, 97-99%, straw color, in drums.....gal.	.80-	.85
Creosylic acid, 95-97%, dark, in drums.....gal.	.85-	.90
Creosylic acid, 50%, first quality, drums.....gal.	.60-	.65
Dichlorobenzol.....lb.	.07-	.10
Diethylaniline.....lb.	1.40-	2.25
Dimethylaniline.....lb.	.58-	.63
Dinitrobenzol.....lb.	.27-	.37
Dinitrochlorobenzol.....lb.	.25-	.30
Dinitronaphthalene.....lb.	.45-	.55
Dinitrophenol.....lb.	.27-	.36
Dinitrotoluenol.....lb.	.38-	.45
Diphenylamine.....lb.	.38-	.65
Diphenylamine.....gal.	.58-	.75
H-acid.....lb.	1.55-	1.70
Metaphenylenediamine.....lb.	1.10-	1.25
Monochlorobenzol.....lb.	.12-	.15
Monothylaniline.....lb.	1.50-	1.75
Naphthalene crushed, in bbls. (250 lb.).....lb.	.06-	.08
Naphthalene, flake.....lb.	.06-	.07
Naphthalene, balls.....lb.	.08-	.10
Naphthionic acid, crude.....lb.	.75-	1.25
Nitrobenzol.....lb.	.35-	.45
Nitro-naphthalene.....lb.	.40-	.50
Nitro-toluenol.....lb.	.375-	.425
Ortho-amidophenol.....lb.	.15-	.20
Ortho-dichlorobenzol.....lb.	.90-	1.25
Ortho-nitrophenol.....lb.	.25-	.40
Ortho-nitro-toluenol.....lb.	.25-	.32
Ortho-toluidine.....lb.	2.75-	3.50
Para-amidophenol, base.....lb.	2.75-	3.25
Para-amidophenol, HCl.....lb.	2.15-	2.18
Para-dichlorobenzol.....lb.	1.10-	1.20
Paranitraniline.....lb.	1.35-	1.50
Para-nitro-toluenol.....lb.	2.50-	3.00
Paraphenylenediamine.....lb.	1.75-	2.05
Paratoluidine.....lb.	1.00-	1.50
Phthalic anhydride.....lb.	.16-	.17
Phenol, U. S. P., drums (dest.), (240 lb.).....lb.		
Pyridin.....gal.	2.50-	3.75
Resorcin, technical.....lb.	6.50-	6.75
Resorcin, pure.....lb.	.45-	.50
Salicylic acid, tech., in bbls. (110 lb.).....lb.	.55-	.60
Salicylic acid, U. S. P. lb.	.90-	.95
Salol.....lb.	.20-	.27
Solvent naphtha, water-white, in drums, 100 gal. gal.	.18-	.24
Solvent naphtha, crude, heavy, in drums, 100 gal. gal.	.25-	.30
Sulphanilic acid, crude.....lb.		

Tolidine.....	lb.	\$1.70	—	\$2.50
Toluidine, mixed.....	lb.	.45	—	.55
Toluol, in tank cars.....	gal.	.26	—	..
Toluol, in drums.....	gal.	.27	—	.30
Xylidine, drums, 100 gal.....	lb.	.44	—	.50
Xylol, pure, in drums.....	gal.	.37	—	.45
Xylol, pure, in tank cars.....	gal.	.35	—	..
Xylol, commercial, in drums, 100 gal.....	gal.	.23	—	.27
Xylol, commercial, in tank cars.....	gal.	.22	—	..

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow.....	lb.	\$0.41	—	\$0.43
Beeswax, refined, yellow.....	lb.	.48	—	.51
Beeswax, white pure.....	lb.	.65	—	.68
Carnauba, No. 1.....	lb.	.84	—	.86
Carnauba, No. 2, regular.....	lb.	.75	—	.78
Carnauba, No. 3, North Country.....	lb.	.47	—	.48
Japan.....	lb.	.19	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb.	.06	—	..
Paraffine waxes, crude, scale 124-126 m.p.....	lb.	.06	—	.07
Paraffine waxes, refined, 118-120 m.p.....	lb.	.08	—	.09
Paraffine waxes, refined, 128-130 m.p.....	lb.	.09	—	.09
Paraffine waxes, refined, 133-135 m.p.....	lb.	.11	—	.11
Paraffine waxes, refined, 135-137 m.p.....	lb.	.12	—	.13
Stearic acid, single pressed.....	lb.	.23	—	.26
Stearic acid, double pressed.....	lb.	.28	—	.29
Stearic acid, triple pressed.....	lb.	.32	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940.....	gal.	\$1.10	—	..
Pine oil, pure, dest. dist.....	gal.	.96	—	..
Pine tar oil, ref., sp. gr. 1.025-1.035.....	gal.	.45	—	..
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.34	—	..
Pine tar oil, double ref., sp. gr. 0.965-0.990.....	gal.	.65	—	..
Pine tar, ref., thin, sp. gr. 1.080-1.960.....	gal.	.38	—	..
Turpentine, crude, sp. gr. 0.900-0.970.....	gal.	.85	—	..
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990.....	gal.	.30	—	..
Pinewood creosote, ref.....	gal.	.48	—	..

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.....	280 lb.	\$17.50	—	\$17.80
Rosin E-I.....	280 lb.	17.75	—	20.00
Rosin K-N.....	280 lb.	21.50	—	22.75
Rosin W. G.-W. W.....	280 lb.	23.25	—	24.50
Wood rosin, bbl.....	280 lb.	17.00	—	17.50
Spirits of turpentine.....	gal.	1.70	—	..
Wood turpentine, steam dist.....	gal.	1.50	—	..
Wood turpentine, dest. dist.....	gal.	1.48	—	..
Pine tar pitch, bbl.....	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.).....	bbl.	14.50	—	14.75
Retort tar, bbl.....	280 lb.	15.00	—	..
Rosin oil, first run.....	gal.	.86	—	.91
Rosin oil, second run.....	gal.	.88	—	.93
Rosin oil, third run.....	gal.	.95	—	1.10
Rosin oil, fourth run.....	gal.	1.05	—	1.15

Solvents

73-76 deg., steel bbls. (85 lb.).....	gal.	\$0.33	—	..
70-72 deg., steel bbls. (85 lb.).....	gal.	.31	—	..
68-70 deg., steel bbls. (85 lb.).....	gal.	.30	—	..
V. M. and P. naphtha, steel bbls. (85 lb.).....	gal.	.23	—	..

Crude Rubber

Para-Upriver fine.....	lb.	\$0.51	—	\$0.52
Upriver coarse.....	lb.	.35	—	.35
Upriver caucho ball.....	lb.	.35	—	.35
Plantation—First latex crepe.....	lb.	.54	—	..
Ribbed smoked sheets.....	lb.	.53	—	..
Brown crepe, thin, clean.....	lb.	.48	—	..
Amber crepe No. 1.....	lb.	.51	—	..

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.....	lb.	\$0.18	—	\$0.19
Castor oil, AA, in bbls.....	lb.	.21	—	.22
China wood oil, in bbls.....	lb.	.22	—	.23
Cocoonut oil, Ceylon grade, in bbls.....	lb.	.18	—	.18
Cocoonut oil, Cochon grade, in bbls.....	lb.	.19	—	.20
Corn oil, crude, in bbls.....	lb.	.18	—	.18
Cottonseed oil, crude (f.o.b. mill).....	lb.	.19	—	.20
Cottonseed oil, summer yellow.....	lb.	.23	—	.25
Cottonseed oil, winter yellow.....	lb.	.24	—	.25
Linseed oil, raw, car lots.....	gal.	..	—	1.75
Linseed oil, raw, tank cars.....	gal.	..	—	1.70
Linseed oil, boiled, car lots.....	gal.	1.75	—	1.77
Olive oil, commercial.....	gal.	2.40	—	2.50
Palm, Lagos.....	lb.	.17	—	.17
Palm, bright red.....	lb.	.16	—	.17
Palm, Niger.....	lb.	.16	—	.17
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.23	—	.23
Peanut oil, refined, in bbls.....	lb.	.26	—	.27
Rapeseed oil, refined in bbls.....	gal.	1.50	—	1.60
Rapeseed oil, blown, in bbls.....	gal.	1.67	—	1.70
Soya bean oil (Manchurian), in bbls., N. Y.....	lb.	.17	—	.18
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.16	—	.16

FISH

Winter pressed Menhaden.....	gal.	\$1.20	—	..
Yellow bleached Menhaden.....	gal.	1.23	—	..
White bleached Menhaden.....	gal.	1.25	—	..
Blown Menhaden.....	gal.	1.30	—	..

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated.....	ton	\$25.00	—	\$36.00
Barytes, off color.....	ton	20.00	—	25.00
Blanc fixe, dry.....	lb.	.03	—	.04
Blanc fixe, pulp.....	ton	35.00	—	47.50
Casein.....	lb.	.16	—	.18
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.04	—	.06

Chalk, English, dense.....	lb.	\$.04	—	\$.05
China clay (Kaolin), imported, lump.....	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered.....	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump.....	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered.....	ton	25.00	—	40.00
Felspar.....	ton	12.50	—	17.00
Fluorspar, acid grade, lump, f.o.b. mines.....	net ton	30.00	—	35.00
Fluorspar, acid grade, ground, f.o.b. mines.....	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered.....	ton	25.00	—	30.00
Fuller's earth, imported, powdered.....	ton	35.00	—	40.00
Pumice stone, imported.....	lb.	.03	—	.06
Pumice stone, domestic.....	lb.	.02	—	..
Shellac, TN.....	lb.	1.10	—	1.13
Shellac, D. C.....	lb.	..	—	..
Shellac, V. S. O.....	lb.	..	—	..
Shellac, Diamond I.....	lb.	..	—	..
Shellac, orange, fine.....	lb.	1.05	—	..
Shellac, orange, superfine.....	lb.	1.20	—	1.30
Shellac, A. C. garnet.....	lb.	1.00	—	..
Shellac, bleached, bone dry.....	lb.	1.25	—	..
Shellac, bleached, fresh ground.....	lb.	1.20	—	..
Soapstone.....	ton	15.00	—	25.00
Talc, domestic.....	ton	16.00	—	60.00
Talc, imported.....	ton	60.00	—	70.00

Refractories

Following prices are f.o.b. works:

Chrome brick.....	net ton	80-90 at Chester, Penn.
Chrome cement.....	net ton	45-50 at Chester, Penn.
Clay brick, 1st quality fireclay.....	net ton	35-45 at Clearfield, Penn.
Clay brick, 2nd quality.....	net ton	30-35 at Clearfield, Penn.
Magnesite, dead burned.....	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4 1/2 x 2 1/2 in.....	net ton	80-90 at Chester, Penn.
Silica brick.....	net ton	41-45 at Mt. Union, Penn.

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon.....	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon.....	lb.	.70	—	..
Ferro-manganese, 70-80% Mn.....	gross ton	110.00	—	115.00
Spiegelisen, 16-20% Mn.....	gross ton	33.00	—	36.00
Ferro-molybdenum, per lb. of Mo.....	lb.	2.50	—	3.00
Ferro-silicon, 50%.....	gross ton	85.00	—	95.00
Ferro-silicon, 75%.....	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%.....	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.....	lb.	1.25	—	1.40
Ferro-uranium, 35-50%, of U.....	lb.	7.00	—	..
Ferro-vanadium, 30-40% per lb. of contained V.....	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40%, C ₂ O ₃	unit	\$0.60	—	\$0.80
Chrome ore, 48% and over.....	unit	.90	—	1.00
Coke, foundry, f.o.b. ovens.....	net ton	7.00	—	8.00
Coke, furnace, f.o.b. ovens.....	net ton	6.00	—	6.50
Petroleum coke, refinery, Atlantic seaboard.....	net ton	12.00	—	12.50
Fluorspar, gravel, f.o.b. mines.....	net ton	..	—	25.00
Manganese ore, 45% Mn and over.....	unit	.50	—	.75
Manganese ore, chemical (MnO ₂).....	gross ton	60.00	—	70.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	9.00	—	15.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃	unit	7.50	—	10.00
Uranium oxide, 96%.....	lb.	..	—	..
Vanadium pentoxide, 99%.....	lb.	6.00	—	..
Pyrites, foreign, lump.....	unit	.17	—	..
Pyrites, foreign, fine.....	unit	.17	—	..
Pyrites, domestic, fine.....	unit	.16	—	.17
Ilmenite, 52% TiO ₂ , f.o.b. N. Y.....	net ton	40.00	—	..
Rutile, 95% TiO ₂ , f.o.b. N. Y.....	net ton	220.00	—	..
Carnotite, minimum 2% U ₃ O ₈ , per lb. of U ₃ O ₈	lb.	2.75	—	3.00
Zircon, washed, iron free, f.o.b. N. Y.....	net ton	200.00	—	..
Monazite, per unit of ThO ₂ , f.o.b. N. Y.....	unit	42.00	—	..

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags.....	bbl.	\$2.80	—	..
Lump lime, common, including container.....	300 bbl.	2.65	—	..
Common brick, at dock.....	M.	16.00	—	..
Yellow pine, 3x4 to 8x8, 20 ft. and under.....	M.	48.00	—	..
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago.....	M.	50.00	—	..
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis.....	M.	40.00	—	..
Roofings, tar felt (14 lb. per 100 sq. ft.).....	ton	70.00	—	..
Roofings, tar pitch (in 400-lb. bbl.) carlots.....	ton	21.00	—	..
Roofings, asphalt pitch carlots.....	ton	34.00	—	..
Roofings, asphalt felt carlots.....	ton	63.00	—	..
Roofings, slate-surfaced, per roll of 108 sq. ft. carlots.....	..	2.25	—	..
Roofings, slate-finished shingles, 100 sq. ft. carlots.....	..	6.00	—	..
Linseed oil, raw in barrels.....	gal.	1.75	—	..
Linseed oil, 5 gal. cans.....	gal.	1.90	—	..
Red lead, dry, 100 lb. keg.....	lb.	.13	—	..
Red lead, in oil, 100 lb. keg.....	lb.	.14	—	..
Red lead, dry, 5 lb. cans.....	lb.	.15	—	..
Red lead, in oil, 5 lb. cans.....	lb.	.16	—	..
White lead, dry and in oil, 100 lb. keg.....	lb.	.13	—	..
White lead, dry and in oil, 25 and 50 lb. kegs.....	lb.	.13	—	..
White lead, dry and in oil, 5 lb. cans.....	lb.	.15	—	..

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.....	100 lb.	\$2.45	—	..
Angles, 3 to 6-in., 1/2-in. thick.....	100 lb.	2.45	—	..
Tees, 3-in. and larger.....	100 lb.	2.45	—	..
Plates.....	100 lb.	2.66	—	..
Rivets, structural, 1/2-in. and larger.....	100 lb.	4.20	—	..
Rivets, conehead for boilers, 1/2-in. and larger.....	100 lb.	4.30	—	..
Sheets, No. 28 black.....	100 lb.	4.35	—	..
Sheets, No. 10 blue annealed.....	100 lb.	3.55	—	..
Sheets, No. 28 galvanized.....	100 lb.	5.70	—	..

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

Current Market Reports

The Non-Ferrous Metal Market

New York, Nov. 21—There is little business in copper, even at the comparatively low price of 20c. (electrolytic). The tin market is sagging, with prices from 2 to 3c. lower than the high quotations for spot tin that prevailed during the dock strike, straits spot being freely offered at 53 to 53½c.

	Cents per Lb.
Aluminum, virgin ingots.....	33.00
Antimony, spot wholesale.....	9.25
Lead, New York.....	6.80
St. Louis.....	6.55
Nickel, ingot.....	42.00
Shot.....	43.00
Electrolytic.....	45.00
Zinc, New York.....	8.12
East St. Louis.....	7.75
Copper, soft untrimmed anodes.....	27.50
Copper, soft-rolled.....	28.25
Copper sheets, hot-rolled.....	30.00
Copper sheets, cold-rolled.....	32.00
Copper bottoms.....	38.00
Copper rods.....	27.00
Copper wire.....	23.75
High brass wire and sheets.....	25.25
Low brass rods.....	28.50
Brased brass tubing.....	37.00
Brased bronze tubing.....	42.25
Seamless copper tubing.....	34.50
Seamless bronze tubing.....	40.00
Seamless brass tubing.....	33.50
Copper nickel, hot-rolled rods (Constantan).....	52.00
Monel metal, ingots.....	38.00
Monel metal, hot rolled sheets.....	55.00
Manganese nickel, cold drawn rods.....	70.00

The Iron and Steel Market

The iron and steel strike has been crumbling so rapidly that it is regarded as virtually over, but even with the return of the last of the strikers the mills would not be fully manned, in point of numbers, while really efficient operation cannot be expected for some time, possibly a few weeks, perhaps six months. There was a labor shortage before the strike and there will be at least as great a labor shortage afterwards. Temporarily at least the situation in this respect is made more acute by various mills adopting the 8-hr. shift in place of the 12-hr. shift.

VARYING PRICES

In steel products there are two classes of producers, from the price standpoint, and eventually there will be two sharply distinguished markets, one for delivery at mill convenience, the other for relatively prompt shipment. The Steel Corporation and some of the leading independents constitute one class of sellers, committed to the maintenance of March 21 prices, while the other class is composed of all the other producers. The last lines in which the Steel Corporation has entered the market for 1920 are sheets and tin plates, the American Sheet & Tin Plate Co. having opened its order books Nov. 15 for first quarter contracts in the case of jobbers and for first half contracts in the case of manufacturing consumers. Prices are strictly those of the March 21 schedule: Tin plate, \$7 per base box for 100-lb. plates; black sheets, 28 gage, 4.35c.; galvanized sheets, 28 gage, 5.70c.; blue annealed sheets, 10 gage, 3.55c., per lb., f.o.b. Pittsburgh.

Some independent sheet mills have been contracting with regular customers of long standing at these prices, but in all cases the tonnages sold are likely to prove less than the consumers require. Already some consumers have approached independent mills, stating that they could not place their entire tonnages at March 21 prices and expressing a willingness to pay advances for the balance they require.

PIG IRON

Pig iron is advancing at the rate of not far from a dollar a ton a week and is now about \$5 a ton, on an average, above the recent minimum, which fell about the beginning of July. The market for early deliveries now stands about as follows for foundry iron: Delivered Philadelphia, \$36.10; f.o.b. Buffalo, \$35; delivered Cleveland, \$32.40; f.o.b. Chicago, \$32; f.o.b. Birmingham, \$31. At valley furnaces the market stands: Bessemer, \$31.50; basic, \$30; malleable, \$32 to \$33; foundry, \$33 to \$34; freight to Pittsburgh being \$1.40.

The Chemical Market

New York, November 22, 1919.

The only development of note in the heavy chemical market since the last review is the receipt of a number of inquiries from Europe. The vegetable oil market fluctuated slightly during the early part of the week, and now shows indications of a decline. China-wood and peanut oils have been exceptions, however, they alone holding fairly steady. Despite the fact that quantities of linseed oil have arrived from England, this oil continues to maintain its ground in the local market. Fish oils have been receiving a fair export inquiry. As has been the case for a time, the para grades of rubber are quiet while trading in plantation grades by dealers is active. Ribbed smoked sheets, after dropping to 51½c. per lb. for January-June delivery, recovered to 53c.

That business in the ceramic trade and among glass, enamel-ware and varnish manufacturers is thriving is revealed by the fact that producers of feldspar are pushed to the limit to meet requirements. The consumption of barytes and blanc fixe is greater than the output, with the result that there is little of either in the open market. A large quantity of barytes has been shipped to Europe (England in particular) and to South America. Heavy demand and inability to furnish supplies led to the increases in price in barytes; domestic, white, rose from \$25-36 to \$35-40 per ton, while blanc fixe, pulp, was raised from \$35-47.50 to \$47.50-50.

HEAVY CHEMICALS

Sodium bichromate, that periodically fluctuating chemical, maintains the peak of interest in the local market. The price is 15-16c per lb. Both potassium-sulphate and potassium-muriate are difficult to locate at \$225 and \$200 per ton, respectively. Both caustic soda and soda ash are well controlled by manufacturers, with pleasing demand. Manufacturers are asking \$3.48 per cwt., f.o.b. works, for caustic and \$2.10-\$2.15 for the ash.

For sodium cyanide, 96-98 per cent, on contract over 1920, 25c per lb. is being quoted, 30c being the price for spot.

Chicago, November 20, 1919.

Under impetus of heavy export sales, soda ash and bleach have shown a slight advance, \$2.10 per cwt., f.o.b. works, now being asked, as against a price of \$2.05 previously. Caustic soda is very firm at \$3.35 per cwt. for the solid, an advance of 10c over previous quotation. The price of \$4 still holds good for caustic in granulated form. Sodium bichromate is repeating its performance of last July, having advanced 2c since early in October, 15c now being the current quotation. Acid prices, in the main, are steady. Current acid quotations are as follows: Sulphuric, 66 deg., \$20; 60 deg., \$13 per ton. Muriatic, 20 deg., \$12.25 in carloads.

Except for anilines, there have been no fluctuations in coal-tar products. The continued acute shortage in aniline oil has forced the price up to 33c., in drums, for less than earload lots, 32c. in carlots. Salicylic acid has again advanced after a slight fluctuation, and is now held firm at 45c.

All oils are holding the gain made three weeks ago, after the sharp slump the early part of October, the only change in price in the local market being in cottonseed oil, current quotation on crude now being 17c. Prime summer yellow holds at 24c. Corn oil holds at 18-18½c., depending on quantity, and linseed seems to have settled at \$1.73 per gal.

FLOTATION OILS, NAVAL STORES

Pine oil, with demand from metal workers steadily increasing and supply undeniably short, continues to advance; .933 pure steamed distilled is now quoted at \$1.35 per gal. in car lots, \$1.40 for less quantity, and destructively distilled brings \$1.25. There is none of the .920 grade of distilled being offered in this market. Turpentine is again up to \$1.72, and with a continuation of export sales, a higher figure can be anticipated. Rosin has shared in the general advance, with current quotation of F grade, \$19 and on WW grade \$24.50.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, NOV. 24 1919

	Carlots	Less Carlots
Acetic anhydride.....lb.	\$0.131-\$0.14	15 - 15 1/2
Acetone.....lb.	2.50 - 2.65	3.00 - 3.25
Acetic, 28 per cent.....cwt.	5.00 - 5.50	6.00 - 6.50
Acetic, 56 per cent.....cwt.	12.00 - 12.50	12.90 - 13.50
Acetic, glacial, 99 1/2 per cent, carboys.....cwt.	12 - 13 1/2	13 1/2 - 14
Boric, crystals.....lb.	12 - 13 1/2	13 1/2 - 14
Boric, powder.....lb.	12 - 13 1/2	13 1/2 - 14
Hydrochloric, (muriatic) tech. 20 deg.....cwt.	1.50 - 1.75	2.00 - 2.50
Hydrofluoric, 52 deg.....lb.	12 - 13 1/2	13 1/2 - 14
Lactic, 44 per cent. tech.....lb.	11 - 14	12 - 16
Lactic, 22 per cent. tech.....lb.	05 - 06	05 1/2 - 07
Molybdenic, C. P.....lb.	4.00 - 4.25	07 - 08 1/2
Nitric, 40 deg.....lb.	06 - 06 1/2	07 - 08 1/2
Nitric, 42 deg.....lb.	07 - 07 1/2	08 - 09
Oxalic, crystals.....lb.	22 - 24	25 - 30
Phosphoric, Ortho, 50 per cent. solution.....lb.	10 - 11	11 - 14
Picric.....lb.	30 - 35	40 - 50
Pyrogallol, resublimed.....lb.	2.30 - 2.60	2.30 - 2.60
Sulphuric, 60 deg., tank cars.....ton	12.00 - 16.00	22.00 -
Sulphuric, 60 deg., drums.....ton	17.00 -	22.00 -
Sulphuric, 60 deg., carboys.....ton	20.00 -	25.00 -
Sulphuric, 66 deg., tank cars.....ton	17.00 - 18.00	22.00 - 23.00
Sulphuric, 66 deg., drums.....ton	20.00 - 21.00	25.00 - 26.00
Sulphuric, 66 deg., carboys.....ton	25.00 -	30.00 - 40.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars.....ton	20.00 -	26.00 -
Sulphuric, fuming, 20 per cent. (oleum) drums.....ton	25.00 -	32.00 -
Sulphuric, fuming, 20 per cent. (oleum) carboys.....ton	30.00 -	35.00 -
Tannic, U. S. P.....lb.	1.35 - 1.45	1.35 - 1.45
Tannic (tech.).....lb.	42 - 55	42 - 55
Tartaric, crystals.....lb.	72 - 74	72 - 74
Tungstic, per lb. of WO.....lb.	1.20 - 1.40	1.20 - 1.40
Alcohol, Ethyl.....gal.	4.90 -	4.95 -
Alcohol, Methyl.....gal.	1.40 -	1.43 -
Alcohol, denatured, 188 proof.....gal.	58 - 60	60 - 64
Alcohol, denatured, 190 proof.....gal.	54 - 56	56 - 60
Alum, ammonia lump.....lb.	03 1/2 - 04 1/2	04 1/2 - 04 1/2
Alum, potash lump.....lb.	07 1/2 - 07 1/2	08 - 09
Alum, chrome lump.....lb.	15 - 16	18 - 20
Aluminum sulphate, commercial.....lb.	01 1/2 - 02	02 1/2 - 02 1/2
Aluminum sulphate, iron free.....lb.	02 1/2 - 03	03 1/2 - 03 1/2
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	08 -	08 1/2 - 08 1/2
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.	30 - 35	30 - 35
Ammonium carbonate, powder.....lb.	13 - 13 1/2	14 - 14 1/2
Ammonium chloride, granular (white sal-ammoniac).....lb.	12 1/2 - 13	13 1/2 - 14
Ammonium chloride, granular (gray sal-ammoniac).....lb.	12 - 12 1/2	13 - 13 1/2
Ammonium nitrate.....lb.	10 -	11 - 12
Ammonium sulphate.....lb.	05 1/2 -	06 - 06 1/2
Amyl acetate.....gal.	3.65 - 3.75	3.65 - 3.75
Arsenic, oxide, lumps (white arsenic).....lb.	10 1/2 - 11	10 1/2 - 11
Arsenic, sulphide, powdered (red arsenic).....lb.	23 - 24	23 - 24
Barium chloride.....ton	85.00 -	90.00 - 100.00
Barium dioxide (peroxide).....lb.	22 -	24 -
Barium nitrate.....lb.	10 - 10 1/2	11 - 12
Barium sulphate (precip.) (blanc fixe).....lb.	03 - 03 1/2	03 1/2 - 04
Bleaching powder (see calcium hypochlorite).....lb.	-	-
Blue Vitriol (see copper sulphate).....lb.	-	-
Borax (see sodium borate).....lb.	-	-
Brimstone (see sulphur, roll).....lb.	-	-
Bromine.....lb.	65 - 75	65 - 75
Calcium acetate.....cwt.	2.00 - 2.05	2.10 -
Calcium carbide.....lb.	04 1/2 - 05	04 1/2 - 05
Calcium chloride, fused, lump.....ton	19.00 - 25.00	30.00 - 40.00
Calcium chloride, granulated.....lb.	01 1/2 - 01 1/2	02 - 02 1/2
Calcium hypochlorite (bleaching powder).....cwt.	2.25 - 2.50	2.25 -
Calcium peroxide.....lb.	1.50 - 1.70	1.50 - 1.70
Calcium phosphate, monobasic.....lb.	75 -	75 -
Calcium sulphate, precipitated.....lb.	09 - 09 1/2	09 - 09 1/2
Carbon bisulphide.....lb.	06 -	06 1/2 -
Carbon tetrachloride, drums.....lb.	10 - 11	12 - 14
Carbonyl chloride (phosgene).....lb.	75 -	75 -
Caustic potash (see potassium hydroxide).....lb.	-	-
Caustic soda (see sodium hydroxide).....lb.	-	-
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	05 - 05 1/2	08 -
Cobalt oxide.....lb.	1.50 - 1.55	1.50 - 1.55
Copperas (see iron sulphate).....lb.	-	-
Copper carbonate, green precipitate.....lb.	28 - 31	28 - 31
Copper cyanide.....lb.	65 - 70	65 - 70
Copper sulphate, crystals.....lb.	08 1/2 - 08 1/2	09 - 09 1/2
Cream of tartar (see potassium bitartrate).....lb.	-	-
Epsom salt (see magnesium sulphate).....lb.	-	-
Formaldehyde, 40 per cent.....lb.	19 - 30	19 - 30
Glauber's salt (see sodium sulphate).....lb.	-	-
Glycerine.....lb.	20 1/2 - 21	20 1/2 - 21
Iodine, resublimed.....lb.	4.50 -	4.50 -
Iron oxide, red.....lb.	03 - 20	03 - 20
Iron sulphate, (copperas).....cwt.	1.00 -	1.20 - 1.50
Lead acetate, normal.....lb.	12 1/2 - 14 1/2	12 1/2 - 14 1/2
Lead arsenate (paste).....lb.	13 - 17	13 - 17
Lead nitrate, crystals.....lb.	85 - 86 1/2	85 - 86 1/2
Litharge.....lb.	09 1/2 - 10 1/2	09 1/2 - 10 1/2
Lithium Carbonate.....lb.	50 -	50 -
Magnesium carbonate, technical.....lb.	13 - 14 1/2	13 - 14 1/2
Magnesium sulphate, U. S. P.....100 lb.	2.00 - 2.63	2.75 - 3.00
Magnesium sulphate, commercial.....100 lb.	1.75 -	2.00 - 2.50
Nickelsalt, double.....lb.	14 -	15 -
Nickelsalt, single.....lb.	12 -	15 - 16
Phosgene (see carbonyl chloride).....lb.	-	-
Phosphorus, red.....lb.	60 - 70	60 - 70
Phosphorus, yellow.....lb.	35 - 37	35 - 37
Potassium bichromate.....lb.	25 1/2 - 26	25 1/2 - 26
Potassium bitartrate (cream of Tartar).....lb.	55 - 60	55 - 60
Potassium bromide, granular.....lb.	74 -	74 -
Potassium carbonate, U. S. P.....lb.	55 - 60	60 - 65
Potassium carbonate, crude.....lb.	23 -	27 -
Potassium chlorate, crystals.....lb.	18 - 20	21 -
Potassium cyanide, 98-99 per cent.....lb.	nominal	30 - 31
Potassium hydroxide (caustic potash).....lb.	25 - 28	30 - 31
Potassium iodide.....lb.	19 -	21 - 3.60
Potassium nitrate.....lb.	-	51 - 58
Potassium permanganate.....lb.	-	1.05 - 1.15
Potassium prussiate, red.....lb.	-	-

	Carlots	Less Carlots
Potassium prussiate, yellow.....lb.	17.00 - 21.00	1.19 -
Potassium sulphate.....ton	225.00 -	80 1/2 - 81 1/2
Rochelle salts (see sodium potas. tartrate).....lb.	-	2.10 -
Sal ammoniac (see ammonium chloride).....lb.	-	2.30 - 2.50
Salt soda (see sodium carbonate).....lb.	-	07 1/2 - 08
Salt cake (sodium sulphate).....ton	-	2.75 - 3.00
Silver cyanide.....oz.	-	16 -
Silver nitrate.....oz.	-	15 - 15 1/2
Soda ash, light.....100 lb.	1.90 - 2.05	2.10 -
Soda ash, dense.....100 lb.	2.15 - 2.25	2.30 - 2.50
Sodium acetate.....lb.	06 1/2 - 07	07 1/2 - 08
Sodium bicarbonate.....100 lb.	2.35 -	2.75 - 3.00
Sodium bichromate.....lb.	15 - 15 1/2	16 -
Sodium bisulphate (nitre cake).....ton	3.00 - 8.00	10.00 -
Sodium bisulphite.....cwt.	1.80 - 1.90	2.00 - 2.10
Sodium borate (borax).....lb.	07 1/2 -	08 - 08 1/2
Sodium carbonate (soda ash).....100 lb.	1.35 - 1.50	1.50 - 1.75
Sodium chlorate.....lb.	12 -	13 - 14
Sodium cyanide, 96-98 per cent.....lb.	30 -	31 - 34
Sodium fluoride.....lb.	15 -	16 - 17
Sodium hydroxide (caustic soda).....100 lb.	3.35 - 3.40	3.45 - 3.50
Sodium molybdate.....lb.	2.50 -	3.25 -
Sodium nitrate.....100 lb.	2.87 1/2 - 3.25	3.75 - 4.00
Sodium nitrite.....lb.	14 - 15	16 -
Sodium peroxide, powdered.....lb.	-	30 - 32
Sodium phosphate, dibasic.....lb.	03 1/2 - 04	04 1/2 - 05
Sodium potassium tartrate (Rochelle salts).....lb.	-	41 - 44
Sodium prussiate, yellow.....lb.	25 - 26	27 - 28
Sodium silicate, solution (40 deg.).....lb.	01 1/2 - 02	02 - 02 1/2
Sodium silicate, solution (60 deg.).....lb.	02 1/2 - 03	03 1/2 - 04 1/2
Sodium sulphate, crystals (Glauber's salts) cwt.	1.15 - 1.25	1.50 - 2.00
Sodium sulphide, crystal, 60-62 per cent. (conce).....lb.	-	05 - 06
Sodium sulphite, crystals.....lb.	03 1/2 -	04 - 06
Strontium nitrate, crystals.....lb.	25 -	28 -
Sulphur chloride.....lb.	05 1/2 -	06 -
Sulphur, crude.....ton	22.00 -	-
Sulphur dioxide, liquid, cylinders.....lb.	-	10 - 12
Sulphur (sublimed), flour.....100 lb.	3.10 - 3.2	3.40 - 3.65
Sulphur, roll (brimstone).....100 lb.	2.95 -	3.15 - 3.40
Tin bichloride (stannous).....lb.	44 -	46 - 50
Tin oxide.....lb.	-	60 -
Zinc carbonate, precipitate.....lb.	-	20 -
Zinc chloride, gran.....lb.	12 1/2 -	13 1/2 - 14
Zinc cyanide.....lb.	49 -	50 -
Zinc dust.....lb.	09 - 11	11 - 14
Zinc oxide, dry American.....lb.	-	09 1/2 - 09 1/2
Zinc sulphate.....lb.	03 1/2 - 03 1/2	04 - 04 1/2

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.00 -	\$1.10
Alpha naphthol, refined.....lb.	1.40 -	1.50
Alpha naphthylamine.....lb.	35 -	50
Aniline oil, drums extra.....lb.	34 -	38
Aniline salts.....lb.	36 -	42
Anthracene, 80% in drums (100 lb.).....lb.	90 -	1.00
Benzaldehyde (f.f.c.).....lb.	1.00 -	1.15
Benzidine, base.....lb.	1.10 -	1.25
Benzidine, sulphate.....lb.	95 -	1.15
Benzoic acid, U. S. P.....lb.	90 -	1.10
Benzoate of soda, U. S. P.....lb.	85 -	1.10
Benzol, pure, water-white, in drums (100 lb.).....gal.	36 -	-
Benzol, 90% in drums (100 lb.).....gal.	24 -	28
Benzyl chloride, 95-97%, refined.....lb.	35 -	40
Benzyl chloride, tech.....lb.	25 -	35
Beta naphthol benzoate.....lb.	3.75 -	4.50
Beta naphthol, sublimed.....lb.	75 -	80
Beta naphthol, tech.....lb.	47 -	55
Beta naphthylamine, sublimed.....lb.	2.25 -	2.35
Cresol, U. S. P., in drums (100 lb.).....lb.	18 -	-
Ortho-cresol, in drums (100 lb.).....lb.	23 -	25
Cresylic acid, 97-99%, straw color, in drums.....gal.	80 -	85
Cresylic acid, 95-97%, dark, in drums.....gal.	85 -	90
Cresylic acid, 50%, first quality, drums.....gal.	60 -	-
Dichlorobenzol.....lb.	07 -	10
Diethylaniline.....lb.	1.40 -	2.25
Dimethylaniline.....lb.	63 -	65
Dinitrobenzol.....lb.	27 -	37
Dinitrochlorbenzol.....lb.	25 -	30
Dinitronaphthalene.....lb.	45 -	55
Dinitrophenol.....lb.	27 -	36
Dinitrotoluol.....lb.	38 -	45
Dip oil, 25% tar acids, ear lots, in drums.....gal.	38 -	65
Diphenylamine.....lb.	58 -	75
H-acid.....lb.	1.55 -	1.70
Metaphenylenediamine.....lb.	1.10 -	1.25
Monochlorobenzol.....lb.	12 -	15
Monoethylaniline.....lb.	1.50 -	1.75
Naphthalene crushed, in bbls. (250 lb.).....lb.	06 -	08
Naphthalene, flake.....lb.	06 1/2 -	07 1/2
Naphthalene, balls.....lb.	08 1/2 -	10
Naphthionic acid, crude.....lb.	75 -	1.25
Nitrobenzol.....lb.	14 -	19
Nitro-naphthalene.....lb.	35 -	45
Nitro-toluol.....lb.	40 -	50
Ortho-amidophenol.....lb.	3.75 -	4.25
Ortho-dichlor-benzol.....lb.	15 -	20
Ortho-nitro-phenol.....lb.	90 -	1.25
Ortho-nitro-toluol.....lb.	25 -	40
Ortho-toluidine.....lb.	25 -	32
Para-amidophenol, base.....lb.	2.75 -	3.50
Para-amidophenol, HCl.....lb.	2.75 -	3.25
Para-dichlor-benzol.....lb.	15 -	18
Paranitraniline.....lb.	1.10 -	1.20
Para-nitro-toluol.....lb.	1.35 -	1.50
Paraphenylenediamine.....lb.	2.50 -	3.00
Paratoluidine.....lb.	1.75 -	2.05
Phthalic anhydride.....lb.	1.00 -	1.50
Phenol, U. S. P., drums (dest.), (240 lb.).....lb.	16 -	17
Pyridin.....gal.	2.50 -	-
Resorcin, technical.....lb.	3.50 -	3.75
Resorcin, pure.....lb.	6.50 -	6.75
Salicylic acid, tech., in bbls. (110 lb.).....lb.	45 -	51
Salicylic acid, U. S. P.....lb.	55 -	61
Salol.....lb.	90 -	95
Solvent naphtha, water-white, in drums, 100 gal.....gal.	20 -	27
Solvent naphtha, crude, heavy, in drums, 100 gal.....gal.	18 -	24
Sulphanilic acid, crude.....lb.	26 -	30

Folidine,.....	lb.	\$1.70	—	\$2.50
Folidine, mixed.....	lb.	.45	—	.55
Toluol, in tank cars.....	gal.	.26	—	.30
Toluol, in drums.....	gal.	.27	—	.30
Xylidine, drums, 100 gal.....	lb.	.44	—	.50
Xylol, pure, in drums.....	gal.	.37	—	.45
Xylol, pure, in tank cars.....	gal.	.35	—	.40
Xylol, commercial, in drums, 100 gal.....	gal.	.23	—	.27
Xylol, commercial, in tank cars.....	gal.	.22	—	.25

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow.....	lb.	\$0.41	—	\$0.43
Beeswax, refined, yellow.....	lb.	.48	—	.51
Beeswax, white pure.....	lb.	.65	—	.68
Carnauba, No. 1.....	lb.	.84	—	.86
Carnauba, No. 2, regular.....	lb.	.75	—	.78
Carnauba, No. 3, North Country.....	lb.	.46	—	.47
Japan.....	lb.	.19	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.....	lb.	.06	—	.07
Paraffine waxes, crude, scale 124-126 m.p.....	lb.	.06	—	.07
Paraffine waxes, refined, 118-120 m.p.....	lb.	.08	—	.09
Paraffine waxes, refined, 128-130 m.p.....	lb.	.09	—	.09
Paraffine waxes, refined, 133-135 m.p.....	lb.	.11	—	.11
Paraffine waxes, refined, 135-137 m.p.....	lb.	.12	—	.13
Stearic acid, single pressed.....	lb.	.23	—	.26
Stearic acid, double pressed.....	lb.	.28	—	.29
Stearic acid, triple pressed.....	lb.	.32	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940.....	gal.	\$1.10	—	
Pine oil, pure, dest. dist.....	gal.	.96	—	
Pine tar oil, ref., sp. gr. 1.025-1.035.....	gal.	.45	—	
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.34	—	
Pine tar oil, double ref., sp. gr. 0.965-0.990.....	gal.	.65	—	
Pine tar, ref., thin, sp. gr. 1.080-1.090.....	gal.	.38	—	
Turpentine, crude, sp. gr. 0.900-0.970.....	gal.	.85	—	
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990.....	gal.	.30	—	
Pinewood creosote, ref.....	gal.	.48	—	

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.....	280 lb.	\$17.50	—	\$17.80
Rosin E-I.....	280 lb.	17.75	—	20.00
Rosin K-N.....	280 lb.	21.50	—	22.75
Rosin W. G. W. W.....	280 lb.	23.25	—	24.50
Wood rosin, bbl.....	280 lb.	17.00	—	17.50
Spirits of turpentine.....	gal.	1.70	—	
Wood turpentine, steam dist.....	gal.	1.50	—	
Wood turpentine, dest. dist.....	gal.	1.48	—	
Pine tar pitch, bbl.....	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.).....	bbl.	14.50	—	14.75
Retort tar, bbl.....	280 lb.	15.00	—	
Rosin oil, first run.....	gal.	.86	—	.91
Rosin oil, second run.....	gal.	.88	—	.93
Rosin oil, third run.....	gal.	.95	—	1.10
Rosin oil, fourth run.....	gal.	1.05	—	1.15

Solvents

73-76 deg., steel bbls. (85 lb.).....	gal.	\$0.33	—	
70-72 deg., steel bbls. (85 lb.).....	gal.	.31	—	
68-70 deg., steel bbls. (85 lb.).....	gal.	.30	—	
V. M. and P. naphtha, steel bbls. (85 lb.).....	gal.	.23	—	

Crude Rubber

Para-Upriver fine.....	lb.	\$0.50	—	\$0.51
Upriver coarse.....	lb.	.34	—	.35
Upriver caucho ball.....	lb.	.35	—	.35
Plantation—First latex crepe.....	lb.	.52	—	.53
Ribbed smoked sheets.....	lb.	.52	—	
Brown crepe, thin, clean.....	lb.	.47	—	.48
Amber crepe No. 1.....	lb.	.50	—	.51

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.....	lb.	\$0.18	—	\$0.19
Castor oil, AA, in bbls.....	lb.	.21	—	.22
China wood oil, in bbls.....	lb.	.22	—	.23
Cocoonut oil, Ceylon grade, in bbls.....	lb.	.17	—	.18
Cocoonut oil, Cochon grade, in bbls.....	lb.	.19	—	.20
Corn oil, crude, in bbls.....	lb.	.18	—	.18
Cottonseed oil, crude (f.o.b. mill).....	lb.	.18	—	.18
Cottonseed oil, summer yellow.....	lb.	.23	—	.24
Cottonseed oil, winter yellow.....	lb.	.24	—	.25
Linseed oil, raw, car lots.....	gal.	1.70	—	1.75
Linseed oil, raw, tank cars.....	gal.	1.65	—	1.70
Linseed oil, boiled, car lots.....	gal.	1.75	—	1.77
Olive oil, commercial.....	gal.	2.50	—	2.80
Palm, Lagos.....	lb.	.17	—	.17
Palm, bright red.....	lb.	.16	—	.17
Palm, Niger.....	lb.	.16	—	.18
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.22	—	.23
Peanut oil, refined, in bbls.....	lb.	.26	—	.27
Rapeseed oil, refined in bbls.....	gal.	1.50	—	1.60
Rapeseed oil, blown, in bbls.....	gal.	1.67	—	1.70
Soya bean oil (Manchurian), in bbls., N. Y.....	lb.	.17	—	.18
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.15	—	.15

FISH

Winter pressed Menhaden.....	gal.	\$1.20	—	
Yellow bleached Menhaden.....	gal.	1.23	—	
White bleached Menhaden.....	gal.	1.25	—	
Blown Menhaden.....	gal.	1.30	—	

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated.....	ton	\$35.00	—	\$40.00
Barytes, off color.....	ton	20.00	—	25.00
Blanc fixe, dry.....	lb.	.03	—	.04
Blanc fixe, pulp.....	ton	47.50	—	50.00
Casein.....	lb.	.16	—	.18
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.04	—	.06

Chalk, English, dense.....	lb.	\$.04	—	\$.05
China clay (Kaolin), imported, lump.....	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered.....	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump.....	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered.....	ton	25.00	—	40.00
Felispap.....	ton	12.50	—	17.00
Fluorspar, acid grade, lump, f.o.b. mines.....	net ton	30.00	—	35.00
Fluorspar, acid grade, ground, f.o.b. mines.....	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered.....	ton	25.00	—	30.00
Fuller's earth, imported, powdered.....	ton	35.00	—	40.00
Pumice stone, imported.....	lb.	.03	—	.06
Pumice stone, domestic.....	lb.	.02	—	.03
Shellac, TN.....	lb.	1.10	—	1.15
Shellac, D. C.....	lb.		—	
Shellac, V. S. O.....	lb.		—	
Shellac, Diamond I.....	lb.		—	
Shellac, orange, fine.....	lb.	1.25	—	
Shellac, orange, superfine.....	lb.	1.20	—	1.30
Shellac, A. C. garnet.....	lb.	1.00	—	
Shellac, bleached, bone dry.....	lb.	1.35	—	
Shellac, bleached, fresh ground.....	lb.	1.10	—	
Soapstone.....	ton	15.00	—	25.00
Talc, domestic.....	ton	16.00	—	60.00
Talc, imported.....	ton	60.00	—	70.00

Refractories

Following prices are f.o.b. works:

Chrome brick.....	net ton	80-90 at Chester, Penn.
Chrome cement.....	net ton	45-50 at Chester, Penn.
Clay brick, 1st quality fireclay.....	1,000	35-45 at Clearfield, Penn.
Clay brick, 2nd quality.....	1,000	30-35 at Clearfield, Penn.
Magnesite, dead burned.....	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4 x 2 1/2 in.....	net ton	80-90 at Chester, Penn.
Silica brick.....	1,000	41-45 at Mt Union, Penn.

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon.....	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon.....	lb.	.70	—	
Ferro-manganese, 70-80% Mn.....	gross ton	110.00	—	115.00
Spiegelisen, 16-20% Mn.....	gross ton	33.00	—	36.00
Ferro-molybdenum, per lb. of Mo.....	lb.	2.50	—	3.00
Ferro-silicon, 50%.....	gross ton	85.00	—	95.00
Ferro-silicon, 75%.....	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%.....	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.....	lb.	1.25	—	1.40
Ferro-uranium, 35-50% of U.....	lb.	7.00	—	
Ferro-vanadium, 30-40% per lb. of contained V.....	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40%, Cr ₂ O ₃	unit	\$0.60	—	\$0.80
Chrome ore, 48% and over.....	unit	.90	—	1.00
Coke, foundry, f.o.b. ovens.....	net ton	7.00	—	7.50
Coke, furnace, f.o.b. ovens.....	net ton	6.00	—	6.50
Petroleum coke, refinery, Atlantic seaboard.....	net ton	12.00	—	12.50
Fluorspar, gravel, f.o.b. mines.....	net ton		—	25.00
Manganese ore, 45% Mn and over.....	unit	.50	—	.75
Manganese ore, chemical (MnO ₂).....	gross ton	60.00	—	70.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	9.00	—	15.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃	unit	7.50	—	10.00
Uranium oxide, 96%.....	lb.	2.75	—	3.00
Vanadium pentoxide, 99%.....	lb.	6.00	—	
Pyrites, foreign, lump.....	unit	.17	—	
Pyrites, foreign, fine.....	unit	.17	—	
Pyrites, domestic, fine.....	unit	.16	—	.17
Ilmenite, 52% TiO ₂	lb.	.02	—	
Rutile, 95% TiO ₂	lb.	.11	—	
Carnotite, minimum 2% U ₃ O ₈ , per lb. of U ₃ O ₈	lb.	2.75	—	3.00
Zircon, washed, iron free.....	lb.	.10	—	
Monazite, per unit of ThO ₂	unit	42.00	—	

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags.....	bbl.	\$2.80	—	
Lump lime, common, including container.....	300 bbl.	2.06	—	
Common brick, at dock.....	M.	16.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under.....	M.	48.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago.....	M.	50.00	—	
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis.....	M.	40.00	—	
Roofings, tar felt (14 lb. per 100 sq. ft.).....	ton	70.00	—	
Roofings, tar pitch (in 400-lb. bbl.) carlots.....	ton	21.00	—	
Roofings, asphalt pitch carlots.....	ton	34.00	—	
Roofings, asphalt felt carlots.....	ton	63.00	—	
Roofings, slate-surfaced, per roll of 108 sq. ft. carlots.....		2.25	—	
Roofings, slate-finished shingles, 100 sq. ft. carlots.....		6.00	—	
Linseed oil, raw in barrels.....	gal.	1.75	—	
Linseed oil, 5 gal. cans.....	gal.	1.90	—	
Red lead, dry, 100 lb. keg.....	lb.	.13	—	
Red lead, in oil, 100 lb. keg.....	lb.	.14	—	
Red lead, dry, 5 lb. cans.....	lb.	.15	—	
Red lead, in oil, 5 lb. cans.....	lb.	.16	—	
White lead, dry and in oil, 100 lb. keg.....	lb.	.13	—	
White lead, dry and in oil, 25 and 50 lb. kegs.....	lb.	.13	—	
White lead, dry and in oil, 5 lb. cans.....	lb.	.15	—	

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.....	100 lb.	\$2.45	—	
Angles, 3 to 6-in., 1-in. thick.....	100 lb.	2.45	—	
Tees, 3-in. and larger.....	100 lb.	2.45	—	
Plates.....	100 lb.	2.60	—	
Rivets, structural, 1-in. and larger.....	100 lb.	4.20	—	
Rivets, conehead for boilers, 1-in. and larger.....	100 lb.	4.35	—	
Sheets, No. 28 black.....	100 lb.	3.55	—	
Sheets, No. 10 blue annealed.....	100 lb.	3.55	—	
Sheets, No. 28 galvanized.....	100 lb.	5.70	—	

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.